UNIVERSITA' CATTOLICA DEL SACRO CUORE
MILANO

Dottorato di ricerca in Politica Economica
ciclo XXII

S.S.D: Economia

International price shocks and development: A general equilibrium approach with applications to Burkina Faso

Tesi di Dottorato di Lorenzo Giovanni Bellù
Matricola: 3580130

Anno Accademico 2009/10

UNIVERSITA' CATTOLICA DEL SACRO CUORE
MILANO

Dottorato di ricerca in Politica Economica

ciclo XXII

S.S.D: Economia

International price shocks and development: A general equilibrium approach with applications to Burkina Faso

Coordinatore: Ch.mo Prof. Luigi Campiglio

Supervisori:
Ch.mo Prof. Francesco Timpano, Università Cattolica del S.C.
Ch.mo Prof. Marco Missaglia, Università degli Studi, Pavia

Tesi di Dottorato di Lorenzo Giovanni Bellù
Matricola: 3580130

Acknowledgements

This thesis is the result of work carried out at different times and in different contexts, largely during week-ends and leave periods. I must credit my wife Maria Angela and my daughters Gloria and Silvia for the support provided, but also for the patience exerted when renouncing to the time and energies I could have dedicated to them. For the remainder of the work, I relied on my professional experiences at FAO. In particular, I strongly benefited form the work I carried out in Burkina Faso. For that, I would like to sincerely thank the national team of policy analysts at the Ministry of Agriculture, in particular Moussa Kaboré, Mamadou Hebié, Adama Ouattara, Richard Guissou and Remi Pale for providing data, information and clarifications about the country. I cannot forget to also thank my colleagues at FAO, in particular Paola Landolfi, Materne Maez, Nathalie Guilbert, Piera Tortora, Ilaria Tedesco, Azeta Cungu and Francesca Battistelli, who provided support, very useful comments and relevant references.

I must also admit that my sisters, brother, relatives and all my friends, who kept asking me "when are you finished with this thesis?", stimulated and supported me to come to an end. Recognition has also to be given to my supervisors, who, during the long process of reading and commenting on the various drafts, became good friends: thank you very much, Francesco and Marco. Significant contributions to improve the thesis also came from two anonymous referees. While thanking them, I also free them (and the supervisors) from responsibility for any mistake or unforgivable omission in the papers.

Last but not least, I feel grateful to my parents: my daddy, who left us a long time ago, and my mummy, to whom I owe what I am.

International price shocks and development: A general equilibrium approach with applications to Burkina Faso

Table of contents:

General introduction.

Part 1:
Development and development paradigms: a (reasoned) review of prevailing visions.

Part 2:
Analyzing policy impacts and international price shocks: Alternative Computable General Equilibrium (CGE) models for an aid-dependent less-industrialized country.

Part 3:
International price shocks in Burkina Faso: assessing development impacts with a Computable General Equilibrium (CGE) approach.

General introduction

This thesis, structured in three individual but logically interlinked papers, aims at addressing select development issues, ideas and perspectives. More specifically, it aims at: 1) examining the recent (and less recent) development thinking; 2) exploring the implications of applying alternative Computable General Equilibrium (CGE) models to analyse development issues of a "paradigmatic" less-industrialized, oil-importing, aid-dependent country; and 3) assessing select development impacts of the international price shocks of food, oil, fertilizers and cotton, experienced in recent years by Burkina Faso.

The main subject of this work is the "development" of socio-economic systems. In general terms, "development" means an event constituting a new stage in a changing situation or the process of change *per se*. If not qualified, "development" is implicitly intended as something positive or desirable. When referring to a society or to a socio-economic system "development" usually means the improvement either of the general system's situation or of some of its constituting elements. Development may occur due to some deliberate action carried out by single agents or by some authority pre-ordered to achieve the improvement, or it may simply occur due to favourable circumstances. Development policies and private investment, in all their forms, are examples of such actions.

Development processes of socio-economic systems present some fundamental features. These include:

1. **Multi-dimensionality.** "Development" is a multi-dimensional concept by nature, because any improvement of complex systems, as indeed actual socio-economic systems are, can occur in different parts, in different ways, at different speeds and driven by different forces. In addition, the development of one part of the system may be detrimental to the development of other parts, giving rise to differing objectives (trade-offs) and conflicts. Consequently, promoting and measuring development, i.e. determining whether and quantifying the extent to which a system is developing, are intrinsically multidimensional exercises, impinging on economic, human, territorial, and environmental dimensions.
2. **Cross-sectoral and macro-micro interdependencies**. A socio-economic system is a set of interconnected elements. Changes in one part of the system are to a greater or lesser extent affecting all the other parts. For instance, changes in factors' availability, allocation, remuneration or mobility affect the entire economic system. Labour, capital, land, as well as natural resources, are used by different sectors which compete for their use. Factors move from one sector to another according to, among other things, the capacity of the different sectors to remunerate them. The development of one sector attracts certain factors, e.g. capital, and releases others, e.g. labour, affecting the factor use in all the other sectors. In addition, the purchasing power of households and their entitlements to food depend on the employment and entrepreneurial opportunities in different parts of the economy, as well as in different geographic locations (e.g. rural versus urban areas). Furthermore, cross-cutting development objectives such as food security and poverty reduction, as well as "balanced" economic growth are better

achieved by adopting a holistic view of the socio-economic system, rather than through isolated sectoral approaches.

3. **Transnational interdependencies.** Countries do not develop in a vacuum. The developmental achievements of a country can be beneficial or detrimental to the development of other countries. Migrations, foreign investment, technology and innovation diffusion, environmental externalities, and international trade are some of the channels through which development processes in one country can "contaminate" other countries.
4. **Long term time-span**. Often policy makers and the development community tend to address development issues as they emerge, focusing on "symptoms" of development-related "diseases", rather than on the "disease" per se. However, while immediate action may relieve direct and severe consequences of contingent crises, to be effective and sustainable, development processes require a long-term vision and lasting action. By way of consequence, immediate development issues need to be framed in a long-term vision for effective and lasting solutions to be found.
5. **Global constraints.** Given the limited amount of resources available globally (energy, metals, land, water, clean air, etc) development processes based on the intensive use of these resources, in particular those which are exhaustible or those which generate large undesirable side-effects or risks, are destined to face resource constraints. Conflicts generated by the need to gain control over scarce resources are the almost unavoidable consequence of such development options.

In light of the above-mentioned features of development processes, and of emerging global development issues such as the overuse of exhaustible energy resources, carbon emissions and climate change, recurrent food crises, the general social and political instability of entire regions, widespread inequalities and persistent poverty and food insecurity, it is particularly important to assess current and recent development processes and to design-redesign ongoing/future processes to find new perspectives for development and related policies.

In the first paper of this work: "*Development and development paradigms: a (reasoned) review of prevailing visions*", an attempt is made to sketch prevailing *development paradigms*, i.e. specific modalities to achieve desirable objectives on the basis of: a vision regarding the functioning and evolution of a socio-economic system; a codified set of activities; and a path to implement them. This exercise aims at contributing to interpret recent and ongoing development processes and support the exploration of alternative development paradigms to address emerging and future development issues. I identify some key "ingredients" of recent and prevailing development "recipes" and explore their mutual cause-effect relationships. In particular, through select contributions in the relevant socio-economic literature, the interactions among economic growth, poverty reduction, agricultural versus industrial development, technological changes and external-transnational factors are highlighted. The analysis of these cause-effect relationships allows for the identification of select development paradigms prevailing in different countries, periods and contexts and the set of development policies designed to implement them. What emerges is that the consensus on how to support development processes is not unanimous, in particular on the desirable degree of openness to international trade, the importance of exports in sustaining development, the type and role of institutions, the

type and role of public policies suitable to govern development processes, and the magnitude of the impacts of external shocks on the domestic socio-economic systems.

A general consensus on all the above is missing despite the great efforts devoted by both academics and policy analysts to assess whether select policies are beneficial or detrimental to development and the extent to which external shocks, e.g. foreign direct investment, foreign aid, remittances and/or international price shocks, affect the development of different countries. Beyond ideological biases, the lack of consensus is partially explained by the complexity of the channels through which policies and external shocks influence socio-economic systems. This complexity is difficult to capture by the various approaches available in the tool-box of analysts, and opens the door to a good degree of subjectivity. This subjectivity is reflected in many aspects of the analyses such as: the choice of the variables to focus on, the benchmark chosen, the assumptions adopted to make the analytical framework manageable, the type of approach adopted (e.g. qualitative versus quantitative or econometric versus computable).

Some of these issues are addressed in the second paper *"Analyzing policy impacts and international price shocks: Alternative Computable General Equilibrium (CGE) models for an aid-dependent less-industrialized country*". This paper, after focusing on the structure of a socio-economic system and on "entry points" of different types of shocks and policies, explores alternative CGE models focusing on macro-economic and factor markets closures. It also highlights how different closures imply different assumptions related to the way the economic system works and adjusts to policies and external shocks.

The focus here on CGEs comes from the long lasting tradition of using CGEs to analyse development issues and related policies. The origins of this tradition date back to the late fifties and early sixties of the past century, with the works of Hirofumi Uzawa, Hollis Chenery and Leif Johansen, who applied the contributions of Kenneth Arrow and Gérard Debreu to create a planning tool aimed at supporting public decision making in providing a better allocation of resources. Since then, CGEs evolved thanks to the evolution of both the solving algorithms and the computers. However, as Lance Taylor reports in his paper in memory of Johansen[1], the evolution of CGEs also followed the flow of the prevailing thinking: in the early eighties, particularly under the influence of the World Bank, the CGEs, were increasingly applied to justify the withdrawal of the government from the economy. Since then, CGEs have been extensively applied in less-industrialized countries to analyze development policy issues and shocks in all those situations where macro-micro interrelationships, cross-sectoral and inter-institutional interdependencies were expected to play an important role. When dealing with development, as opposed to growth, the use of CGEs, which mostly present some degree of disaggregation, is justified because development implies the relative strengthening of some sectors to the detriment of others. This is due, among other, to income shifts affecting the composition of consumers demand. In addition, as demonstrated by Rosenstein-

[1] Taylor L. (2011): CGE applications in development economics. Schwartz Center for Economic Policy Analysis. SCEPA working paper 2011-1

Rodan[2] with his contributions on the "*big push*", the "profitability" of investments, including those geared towards development, depends on the density of the matrix of interindustrial coefficients. Using a multi-sectoral tool such as the CGEs, along the path rooted in Leontief's seminal contributions[3], helps to understand not only how and why income is (or would be) generated, but also how and why it is (or would be) distributed. Of course, there is no need to say that these are important pieces of information for analysts dealing with development issues.

In the second paper, to test how different ways of designing general equilibrium models may influence actual decision making in less industrialized economies, a one-sector, two-household, two-factor general equilibrium model is designed and calibrated on an "archetypical" Social Accounting Matrix of a hypothetical less industrialized, aid-dependent country. Alternative macro-economic and factor market closures are tested focusing on the mechanisms through which the economic system adjusts to external shocks such as import price upward shifts. Conclusions highlight that: 1) different ways of modelling economic systems lead to significantly different impacts of the same simulated external shock on import prices; 2) the results are particularly sensitive to the level of the elasticities of substitution of domestic goods with domestic ones; and 3) in aid-dependent economies, characterized by an high foreign dependency ratio of the government budget and a high level of foreign borrowing due to the external trade deficit, trade shocks affecting the real exchange rate largely affect the system and the welfare of households. By providing and comparing alternative macro-economic model closures and assumptions on factor markets, this paper emphasizes the importance of reading model results in light of the assumptions made and carrying out appropriate sensitivity tests on most relevant parameters.

The third paper, *"International price shocks in Burkina Faso: assessing development impacts with a Computable General Equilibrium (CGE) approach",* focuses on a concrete country case study, analyzing the implications on welfare and growth of recent international price shocks, notably energy and agricultural products, in Burkina Faso. Burkina Faso is an agriculture-based, less industrialised, low-income, food-deficit, and net oil-importing country. Given the importance of agriculture, and considering that all the price shocks at stake directly or indirectly influence agriculture, the paper opens by sketching in general terms the links between agriculture and development. Subsequently the price shock impacts are analysed by means of a CGE. The results show that oil price hikes in recent years had much greater impacts on the welfare of the poorer layers of the population than any other price shifts. The paper also discusses the extent to which technological changes in agriculture, specifically the introduction of "Good Agricultural Practices" (GAP) towards "conservation agriculture", could mitigate the welfare and growth losses derived by international price shocks. It is shown that the technological changes explored in this paper, in spite of their significant impacts on agricultural productivity, cannot countervail the negative welfare and growth losses brought by international price shocks. Energy dependency, particularly in a context of high oil prices, appears

[2] Rosenstein-Rodan, P.N. (1943): Problems of Industrialization of Eastern and South-Eastern Europe. Economic Journal 53 (June-September 1943), 202-211.

[3] Leontief W.W. (1941): The structure of American economy, 1919-1929: an empirical application of equilibrium analysis. Harvard University Press in Cambridge, Mass.

to be a channel that systematically siphons out domestic resources, jeopardizing household welfare and seriously hampering domestic primary capital accumulation and related endogenous-growth potential. Policy implications for poverty reduction and food security are that suitable policies should favour not only the adoption of appropriate energy-saving agricultural technologies but also the exploitation of sustainable energy production potential of rural areas. These findings are likely to apply to other less-industrialised energy-importing countries with a similar socio-economic structure.

As a general lesson, reading across the three papers of this work, it emerges that factors such as: 1) the current and emerging issues affecting the development potential of less-industrialized countries; 2) transnational interdependencies, specifically those related to intensive use of non-renewable or hazardous energy, strongly questioning the sustainability of development achievements in industrialized countries; and 3) global constraints related to carbon emissions and related climate changes, impose a deep revisiting of global and national development paradigms and adjustments. This revisiting and adjustment will probably need to also involve the still prevailing vision according to which selected countries are considered "*developed*", as opposed to others considered "*developing*". There is a clear need to carefully reassess global development achievements to date and identify feasible and effective ways forward to ensure more equitable and sustainable development processes.

International price shocks and development: A general equilibrium approach with applications to Burkina Faso.

Part 1:

Development and development Paradigms: a (Reasoned) review of prevailing Visions.

Tesi di Dottorato di Lorenzo Giovanni Bellù
Matricola: 3580130
Anno accademico 2009-2010

Abstract
This paper attempts to sketch prevailing *development paradigms*, i.e. the definition of modalities to achieve development based on either a codified set of activities and/or based on a vision regarding the functioning and evolution of a socio-economic system. The aim of this exercise would be to contribute to the interpretation of recent past and ongoing development processes and policies and to support the exploration of alternative development paradigms to address emerging and future development issues. After defining the concepts of development and development paradigms, this paper identifies some key "ingredients" of recent and prevailing development "recipes". Mutual links among these "ingredients" are explored through select contributions in the literature which focuses on development issues. On this basis, some cause-effect relationships are highlighted, which are at the basis of most development processes. The analysis of these cause-effect relationships allows for the identification of select development paradigms prevailing in different countries, during different periods and within different development contexts. In light of the emerging issues affecting the sustainability of development achievements in industrialized countries, the concluding remarks reassess the prevailing vision according to which selected countries are considered "*developed*", as opposed to others considered "*developing*".

Table of contents

1 Introduction 4
2 Defining development, development paradigms and development ingredients 4
2.1 Development defined 4
2.2 What should be developed? Dimensions of development 5
2.3 How to develop: development paradigms 7
2.4 Identifying development paradigms and related policies 8
2.5 Disentangling development ingredients 10
3 Economic growth versus poverty and inequality reduction 11
4 Agricultural growth *versus* economic growth 15
5 Technology changes *versus* economic growth. 20
6 Agricultural growth and technological changes versus Poverty reduction 22
7 External factors *versus* growth, poverty, technology and agricultural development 25
8 Development paradigms identified 34
9 Conclusions 36
10 References 38

1. Introduction

In an ever changing context, where emerging issues raise questions to the development community on the way development processes have been and are being designed and supported, it is important to critically assess prevailing visions about development and adapt them, or even adopt alternative, more suitable approaches. As a contribution to this assessment, this paper attempts to sketch prevailing *development paradigms*, i.e. defined visions and related activities regarding the functioning and evolution of socio-economic systems. The aim of this paper is to provide some conceptual elements for further qualitative and quantitative analytical work, to feed the debate on development and related policy decision making processes.

In section 2, after defining the concepts of development and development paradigms, some key "ingredients" of recent past and prevailing development "recipes" are identified. In sections 3 to 7, the mutual links among them are explored through selected contributions in available literature which focuses on development issues. On this basis, some cause-effect relationships are highlighted, which are at the basis of most development processes. The analysis of these cause-effect relationships allows for the identification of selected development paradigms prevailing in different countries, during different periods and within different development contexts. Findings are summarized in Section 8, which also provides some insights on further work to be carried out on their basis. Section 9 provides concluding remarks and section 10 contains a list of references to the various strands of the literature on which the work is based.

2. Defining development, development paradigms and development ingredients

2.1. Development defined

In general terms, "development" means an "event constituting a new stage in a changing situation"[4] or the process of change *per se*. If not qualified, "development" is implicitly intended as something positive or desirable. When referring to a society or to a socio-economic system "development" usually means the improvement either of the general situation of the system, or of some of its constituting elements. Development may occur due to some deliberate action carried out by single agents or by some authority pre-ordered to achieve the improvement, to favourable circumstances or both. Development policies and private investment, in all their forms, are examples of such actions.

Given this broad definition, "development" is a multi-dimensional concept in nature, because any improvement of complex systems as indeed actual socio-economic systems are, can occur in different parts, in different ways, at different speeds and driven by different forces. In addition, the development of one part of the system may be detrimental to the development other parts, giving rise to conflicting objectives (trade-offs) and conflicts. Consequently, measuring development, i.e. determining whether and quantifying the extent to which a system is developing, is an intrinsically multidimensional exercise.

[4] Oxford English Dictionary. http://oxforddictionaries.com

2.2. What should be developed? Dimensions of development

Even if the development of a socio-economic system can be viewed as a holistic exercise, i.e. as an all-encompassing endeavour, for practical purposes, in particular for policy making and development management, the focus of the agents aiming at development is almost always on selected parts of the system or on specific features. To this end, "development" is qualified and specified in different ways. A summary (non-exhaustive) list of possible qualifications comprises:

- **Economic development:** i.e., improvement of the way endowments and goods and services are used within (or by) the system to generate new goods and services in order to provide additional consumption and/or investment possibilities to the members of the system.
- **Human development**: people-centred development, where the focus is put on the improvement of the various dimensions affecting the well-being of individuals and their relationships with the society (health, education, entitlements, capabilities, empowerment etc.)
- **Sustainable development**: development which considers the long term perspectives of the socio-economic system, to ensure that improvements occurring in the short run will not be detrimental to the future status or the development potential of the system, i.e. development will be "sustainable" on environmental, social, financial etc. grounds.
- **Territorial development**: development of a specific region (space) achievable by exploiting the specific socio-economic, environmental and institutional potential of the area, and its relationships with external subjects.

Economic development has been traditionally seen as the first form of development. It has often been strictly associated to the concept of economic growth, in turn defined as an increase in the *per capita* income of the economic system. Indeed, growth defined in this way can be seen more as the result of an economic development process, i.e. the transformation of the structure of an economic system, rather than the development process *per se*. Countless economists provided insights and proposed models to explain how economic systems develop (or should develop) to generate growth. Just to mention some milestones, it is worth to mention the contributions of Shumpeter (1911)[5], who suggested that economic systems evolve through subsequent disequilibria due to agents which introduce innovations, more than "developing" according to a pre-determined path. Ramsey (1928)[6] set a model to maximize the consumption of future generations with endogenous savings, disutility of work and individuals with an infinite time horizon. Allais (1947)[7] (and, later, P. Samuelson) set the first "*overlapping generations model*", where individuals have a finite time horizon but overlap with other individuals living longer. Solow (1956)[8] with his "*Long Run Growth Model"* highlights that, increasing the capital per unit of labour (a shift in the capital/labour ratio) increases labour productivity and generates growth. But factors exhibit diminishing marginal productivity. The diminishing marginal productivity should push the economy at a point where additional capital per worker would have no impact on production. The output would increase only if also labour increases. In this situation, there would be no interest to invest

[5] Shumpeter J. (1911) *The Theory of Economic Development: An inquiry into profits, capital, credit, interest and the business cycle* (original title in German) 1911.

[6] Ramsey F, P.(1928). "A mathematical theory of saving". Economic Journal, vol. 38, no. 152, December 1928, pages 543–559.

[7] Allais M.(1947) *Économie et Intérêt. Présentation nouvelle des problèmes fondamentaux relatifs au rôle économique du taux de intérêt et de leur solutions.* Paris, Imprimerie nationale. Vol 2(1947),

[8] Solow R.M (1956). *A contribution to the theory of economic growth*. The quarterly Journal of Economics Vol 70, No. 1 (Feb.1956). 65-94

more because this would bring no returns. Therefore, output, capital and labour would all increase at the same rate (steady state)[9]. Less-industrialized countries, which enjoy a lower capital/labour ratio, should benefit more of capital increases (investment) than industrialized ones, where the capital/labour ratio is higher. The larger returns on investment in less industrialized countries, (assuming constant returns to scale), should generate convergence between less-industrialized and industrialized countries. However, exogenous technology improvements shift the output pushing forward the steady state. Romer (1986), with his "*endogenous growth model*" questioned the idea of technology shifts as exogenous to the economic system, highlighting how investment and human activities in general have positive spillover effects on knowledge, implying that technology, which is an application of knowledge to production processes, is endogenous, i.e. generated within the economic system. Similarly, impacts of investment in research (innovation) and in human capital on technological changes and growth, have been considered. For instance, Aghion and Howitt (1990)[10] address the issue of research and obsolescence and highlight that the expectations of an accelerated pace of research in the future can depress current research fearing rapid obsolescence of possible innovations (a too fast process of Schumpeterian creative destruction). Galor and Zeira (1993)[11] highlight how strong income inequalities may prevent investment in human capital leading to lower per capita output. Galor and Moav (2004) [12] identify the replacement of physical capital accumulation with human capital accumulation, stimulated by a more equitable income distribution, as an advanced stage along the development process, which sustains the so called "modern growth", as opposed to the "industrial revolution" growth.

Human development. The above-mentioned emphasis on the links between human capital and growth constituted a step towards a multi-dimensional concept of development, where knowledge is not only functional to economic growth but an end *per se*, as it generates empowerment, self-reliance and a general improvement in community and social relationships. Nowadays the concept of development encompasses a set of elements comprised in more than one of the above-mentioned qualifications. UNDP (2010)[13] for instance, provides an aggregate concept of human development and the in the basis of three criteria, i.e. (i) "Long and healthy life", (ii) "knowledge" and (iii) "A decent standard of living", respectively measured by life expectancy at birth, mean years and expected years of schooling and gross national income per capita at purchasing parity. The associated Human Development Index (HDI) is then adjusted on the basis of (iv) the inequality in the

---

[9] Solow accepts almost all the assumptions of the Harrod-Domar model, except the fixed proportions between capital and labour. See: Harrod R. F (1939) An Essay in Dynamic Theory. *The Economic Journal*, Vol. 49, No. 193. (Mar., 1939), pp. 14-33. and: Domar, E. (1946), 'Capital Expansion, Rate of Growth and Employment', *Econometrica*.

1.1. [10] Aghion, P. Howitt,P (1990): A Model of Growth Through Creative Destruction Working Paper No. 3223 January 1990 NBER

[11] Galor, O. and Zeira (1993) Income Distribution and Macroeconomics**.** Review of Economic Studies (1993) 60 (1): 35-52

[12] Galor, O., Moav O. (2004): From Physical to Human Capital Accumulation: Inequality and the Process of Development. Review of Economic Studies, Vol.71, 4, pp 1001-1026, Dec 2004.

[13] UNDP (2010) Human development Report 2010. The real wealth of nations: pathways to human development. http://hdr.undp.org/en/media/HDR_2010_EN_Complete_reprint.pdf

The HDI is calculated as the geometric mean of three indexes for the tree components. Each index ranges between 0 and 1 because the minimum level of the selected measure observed between 1990 and 2010 in any country is set to 0, the maximum level observed is set to 1 and all the other observations are normalized within these bounds. Inequality adjustments are made by means of the Atkinson index of each measure (Atkinson, A. 1970. "On the Measurement of Inequality." *Journal of Economic Theory* 2(3): 244–63).

distribution of the specific feature within country, assuming that the unequal distribution of the wellbeing is an undesirable feature of development processes.

Sustainable development. The Concept of "sustainable development" was firstly introduced by Brundtland (1987)[14], which defines development as "sustainable" if it "*meets the needs of the present without compromising the ability of future generations to meet their own needs*". Sustainable development implies minimizing the use of exhaustible resources, or at least, ensuring that revenues obtained from them are used to ensure a constant flow of income across generations, and making an appropriate use of renewable resources. This applies to energy (oil and oil products in particular) but also to fish stock, wildlife, forests, water, land, air. Land degradation, due to soil erosion and salinization, persistent water and air pollution, depletion of fish stock and deforestation are all examples of consequences of non-sustainable activities. Soil conservation practices, Good Agricultural Practices (GAP) based on reduced use of energy, pesticides and chemicals, waste management and recycling, waste water treatment, use of renewable energy sources such as biomasses and solar panels, are frequently cited as techniques for sustainable development. The concept of sustainability has also been extended beyond environmental concerns, to include social sustainability, i.e. long term acceptance and ownership of development changes by the citizens, their organizations and associations (civil society), and financial and economic sustainability.

Territorial development. This dimension of development refers to a territorial system, intended as a set of interrelationships between rural and urban areas, in a space characterized by the existence of poles of attraction for human activities (production and consumption of goods and services, but also culture and social life), and connected by information systems and transport infrastructures. When referring to production activities, poles of attraction can be characterized as "Clusters" where for various reasons homogeneous or closely interlinked activities are implemented. Territorial systems are open to influences from the national and supra-national contexts and from the interrelationships between territories. Territorial development implies focusing on the assets of the territory, its potentials and constraints (FAO, 2005). Polices to exploit and enhance these potentials play an important role in the development process.

2.3. How to develop: development paradigms

Development was almost never considered to be a "god-given" condition of socio-economic systems, implying that policy makers at national and international level have always thought that some activities (or even refraining from carrying out any activity) were required to promote positive changes. However, countries, as well as the international development community, in different periods have privileged specific ways of achieving development, adhering to a specific "**Development paradigm"** i.e. to a defined modality or a path to follow to achieve development, based on a codified set of activities and/or based on a vision regarding the functioning and evolution of a socio-economic system.

Identifying an exhaustive set of past and present "paradigms" adopted to develop socio-economic systems is a very tall order[15]. The difficulty arises due to various factors such as:

[14] Brundtland (1987) *Our Common Future* (1987), World Commission on Environment and Development (WCED) Oxford: Oxford University Press.

[15] However attempts have been carried out in this direction. See e.g.
Adelman, I., and Morris, C.T., (1967) Society, Politics and Economic Development: a Quantitative Approach. Hopkins Press.

the complexity of the development concept *per se*, and also due to its multidimensional nature; the diversity of countries and country experiences; the different overlapping thoughts and related actions carried out at national, regional and international level; the analytical difficulties to identify cause-effect relationships between development policies and results achieved, controlling for other factors influencing development processes such as endowments, level of well-being achieved so far, geographic location, geo-political and geo-strategic influences, dimensions, degree of social/ethnic homogeneity etc.

Nevertheless, it is particularly important, in the light of emerging global development issues such as the overuse of exhaustible energy sources, carbon emissions and climate change, recurrent food crises, the general social and political instability of entire regions, widespread inequalities and persistent poverty and food security, to assess past processes and design-redesign ongoing/future ones to find new perspectives for development processes and related policies. In this light, and particularly in the light of the unsustainable levels of development of the so called "developed" countries, it is compulsory to fully revisit the way development has been conceived so far and completely reassess the usefulness of the dichotomy "developed" versus "developing" countries. The identification of prevailing development paradigms is a first step in this reassessment process.

2.4. Identifying development paradigms and related policies

To identify prevailing development paradigms and related policies, it may be useful to take a glance at a macroscopic perspective of what is going on in the global development arena. A good starting point are, for instance, the declarations of the G8 Summit on global governance and global food security ("l'Aquila declarations" G8, 2009)[16]. Even if such declarations in general emphasize more development objectives than instruments and processes required to achieve them, some "ingredients" of the prevailing "development recipes" are identifiable, such as: economy-wide growth, increased agricultural production and productivity, support to small scale industries, promotion and protection of innovation, transfer of clean, low-carbon technologies, development of human capital, research, infrastructure, further opening markets to international trade and foreign investment, stability and good governance, social protection mechanisms such as safety nets and social policies for the most vulnerable. Among other things, all this should allow for the achievement of the Millennium Development Goals (MDGs) set by the United Nations at the beginning of the millennium (poverty reduction, food security, health, education, sustainable resource use, good governance)[17]. In particular, all the above should lead to the achievement of the first MDG: *"Eradicate extreme poverty and hunger*", probably the most challenging objective to achieve in a sustainable way[18].

Morris, C. T., Adelman I. (1988) Comparative Patterns of Economic Development, 1850-1914. Hopkins Press

[16] G8 (2009) L'Aquila Joint Declarations: Promoting the Global Agenda (2009) http://www.g8italia2009.it/static/G8_Allegato/G8_G5_Joint_Declaration.pdf and:
L'Aquila Joint Statement on Global Food Security
http://www.g8italia2009.it/static/G8_Allegato/LAquila_Joint_Statement_on_Global_Food_Security[1],0.pdf

[17] United Nations (2000). United Nations Millennium Declaration. Resolution adopted by the General Assembly. 8th plenary meeting, 8 September 2000. http://www.un.org/millennium/declaration/ares552e.htm

[18] For a critique to the MDGs, in particular to the way they have been set without taking into account the specificities of various continents, specifically Africa, see: Easterly W. (2009): How millennium development goals are unfair to Africa. World development, Vol. 37, No. 1, pp. 26–35, 2009

These different "ingredients", interlinked by mutual cause-effect relationships, have been and are currently being mixed in different proportions by all bi-lateral and multi-lateral development agencies, including the Food and Agriculture Organization (FAO)[19], the International Fund for Agricultural Development (IFAD), the United Nations Development Programme (UNDP), the World Bank and the other regional development banks, as well as by different countries in different regions, to create "development recipes" which reflect different development paradigms.

The emphasis given to the different "ingredients" both in the literature and in the development practice (policies, programmes, funding etc), reflects the different visions of what really matters to develop a socio-economic system i.e. the different development paradigms i.e. different visions about what type of development is desirable, and how it is achievable.

However, as both on conceptual grounds and in practice these ingredients are almost often entangled, it may prove useful to gain a better understanding of development and development processes, attempting to disentangle them by analyzing the main mutual cause-effect relationships.
A first way of looking more systematically into these "ingredients" could be to split this broad family into development "objectives", i.e. desirable development achievements, and development "instruments", i.e. means in the hands of policy makers to be used to achieve development objectives. However a conceptual issue arises when attempting this exercise. Given the existing cross linkages and feed-back effects among development "ingredients", it may not always be possible to operate such separation. This applies in particular for all those cases where a development achievement clearly contributes to generate further development, i.e. it becomes instrumental to the achievement of a new (further) development objective. This is the case, for instance of education. A given level of schooling can be considered a development objective, as it is a desirable achievement per se, in terms of increased personal empowerment, more active participation to decision making processes, and social life etc. Though, the achievement of such objective is instrumental to the achievement of other development objectives, such as improved sanitation (through the possibility to read leaflets, effectively use drugs etc) or improved production processes (through increased possibilities to discover innovations, exchange information etc).

A second way of looking to them would be to focus on selected "macro-ingredients" to which the recent (and less-recent) development literature and development practice have given prominence, identifying their mutual cause-effect relationships and other determinants. I will focus on: i) the growth of an economic system, ii) the development of specific sectors, notably agriculture; iii) the level and dynamics of poverty and inequality; iv) technology choices and technological changes in production processes, and v) the influences of external factors and the international context[20].

---

[19] FAO (2003) adopted the so-called *"Twin-Track Approach"*, as the conceptual framework for its "Anti-Hunger Programme". It comprises both programmes aimed at improving the direct and immediate access of food to food-insecure people and interventions aimed at agricultural development and off-farm income generation, on the assumption that there are mutually reinforcing relationships between these components towards food insecurity and poverty reduction. FAO (2003): Anti-Hunger Programme: A twin-track approach to hunger reduction: priorities for national and international action Food and Agriculture Organization of the United Nations. Rome.

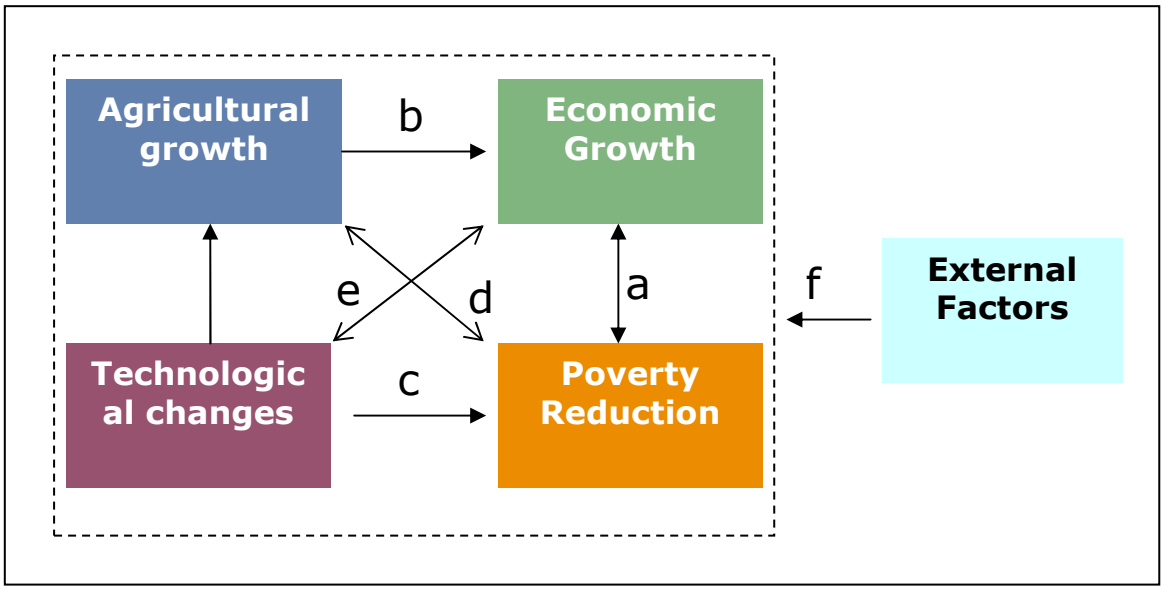
[20] In some contexts the "development community" uses the words "growth" and "development" as almost synonymous, above all when associated to some sectoral-subsectoral qualifiers such as "agricultural growth". This is evident, e.g., looking at:

2.5. Disentangling development ingredients

In the next sections, by means of a reasoned literature review on the above elements, this paper explores some mutual links between the different elements mentioned, notably:

a. Economic growth versus poverty and inequality reduction;
b. Agricultural development versus economic growth;
c. Agricultural development versus poverty and inequality reduction;
d. Technological changes versus poverty and inequality reduction;
e. Technological changes versus economic growth;
f. Influence of external factors on poverty, technological changes and agricultural development (See Figure 1).

Figure 1: Technological changes, Agricultural development, growth and poverty



Cross-linkages among these elements are not easy to disentangle and the different strands of literature dealing with these mutual relationships very often overlap.
Nevertheless, despite the abovementioned practical and conceptual difficulties, an attempt will be made to provide some guiding elements through recent (and less recent) findings in these areas.

The review of the literature on these topics, which by no means intends to be exhaustive, aims at shedding some light on key constituting ingredients of development paradigms and on the development paradigms themselves.

World Bank (2005): Agricultural growth for the poor: an agenda for development. The International Bank for Reconstruction and Development/The World Bank. I adopt here the terminology "agricultural development" as opposed to "agricultural growth" qualifying it as I did for "economic development" versus "economic growth" in section 2.2, i.e. growth, measured in terms of increased output, as a result of a development process (technological change, use of additional factors etc).

3. Economic growth versus poverty and inequality reduction

In analysing the links between growth and inequality, Kutznets (1955)[21] wondered whether the reverse U-shaped relationship between growth and inequality "*...of the older developed countries* [is] *likely to be repeated in the sense that in the early phases of industrialization in the underdeveloped countries income inequalities will tend to widen before the levelling forces become strong enough first to stabilize and then reduce income inequalities*". He particularly addressed the issue of the affordability of the likely increase in inequality, as a price to be paid to achieve growth, in the context of extremely low income levels. Indeed, he underlined the need of what, almost forty years later, would be called "pro-poor growth":

> "*How can either the institutional and political framework of the underdeveloped societies or the processes of economic growth and industrialization be modified to favour a sustained rise to higher levels of economic performance and yet avoid the fatally simple remedy of an authoritarian regime that would use the population as cannon-fodder in the fight for economic achievement? How to minimize the cost of transition and avoid paying the heavy price-in internal tensions, in long-run inefficiency in providing means for satisfying wants of human beings as individuals-which the inflation of political power represented by authoritarian regimes requires?"*

Almost two decades later, economists systematically started exploring the links between the growth of an economic system, which was essentially measured in terms of variation of GDP, and poverty reduction. Chenery and Ahluwalia (1974)[22] pioneered these studies by proposing a model of "*redistribution with Growth*" and underlined the importance of applying re-distributive processes to growth, if poverty had to be reduced.

Since then, several authors have attempted to measure, both theoretically and empirically, the extent to which poverty reduction is related to growth and/or redistribution. For example, Datt and Ravallion (1992)[23] divide poverty changes into three components respectively as growth, inequality changes and a residual component. Kakwani (1993)[24] works out the "Growth elasticity of poverty", i.e. the percentage change in poverty for a 1 percent growth in the mean income of the society, keeping constant the income distribution (as if everyone in the society received the same proportional change of its income). Ravallion and Chen (1997)[25] estimate, on the basis of a sample of less industrialised countries, that the "growth elasticity of poverty" was about - 3, i.e. that 1 percent increase (decrease) in the mean income reduces (increases) the "poverty incidence" by 3 percent[26].

Bourguignon (2003) provides the mathematical link between growth elasticity of poverty reduction and the initial inequality as well as the location of the poverty line in relation to

---

[21] Kuznets S. (1955) Economic Growth and Income Inequality. *The American Economic Review*, Vol. 45, No. 1. (Mar., 1955), pp. 1-28.

[22] Chenery , H., and M. Ahluwalia (1974) Redistribution with Growth. Oxford: Oxford University Press.

[23] Datt, G., and M. Ravallion (1992) Growth and Redistribution Component of changes in Poverty Measures: A Decomposition with Applications to Brazil and India in the 1980s. Journal of development Economics 38, pp275-295.

[24] Kawani N., (1993). Poverty and Economic Growth with Application to Cote d'Ivoire. Review of Income and Wealth 39, 121-139.

[25] Ravallion, M. and Chen S. (1997). What Can New Survey Data Tell us about Recent Changes in Distribution of Poverty? The World Bank Economic Review 11: 357-382.

[26] The "poverty incidence" is the proportion of people with income or expenditure below a given "poverty line", i.e. a threshold that represents the minimum level of income or expenditure required to be considered non-poor.

mean incomes, by assuming that incomes are log-normally distributed. Under this assumption, the complete distribution of income is known, provided information on mean income and the Gini coefficient is available. Bourguignon also identifies a direct link between a permanent redistribution of income and the elasticity of poverty reduction w.r.t. growth. Redistributing income leads to an "*acceleration*" of poverty reduction for a given rate of economic growth, thanks to an increase in the elasticity of poverty reduction to growth associated with the redistributive process.

Ravallion and Chen (2003) develop a pro-poor growth measure, based on the so-called "growth incidence curve" (GIC), which is in turn based on the slopes of the Lorenz curves in two subsequent periods and the growth rate of the mean income[27]. This measure is the mean growth rate of income for the poor and can be interpreted as the ordinary growth rate scaled up or down according to whether the distributional changes were pro-poor or not.

Kakwani and Son (2003), after working out a "Poverty Equivalent Growth Rate"(PEGR) which embodies distributional concerns[28], calculate the PEGR for different countries, namely, Thailand, Korea and Vietnam, and by comparing the PEGR with the actual growth rate, rank countries according to the "pro-poorness" of their growth patterns.

Son (2004) [29] proposes a supposedly "*more conclusive*" pro-poor growth index than the one developed by Ravallion and Chen, as it allows us to judge whether growth is pro-poor or not in most situations, being based on Generalized Lorenz curves (GL), which consider second order dominance, rather than on ordinary Lorenz curves (L) which consider only first order dominance[30]. Furthermore, Son and Kakwani (2008) work out a new "PEGR" and use it to classify growth patterns of eighty countries, finding that "... *global growth processes have not generally been favourable to the poor. The global reduction in poverty would have been much greater if growth were generally positive and pro-poor*"[31].

In tandem, at the beginning of the 2000s a wave of thought rose which somewhat downsized the importance of redistribution for poverty reduction. On the basis of some econometric work based on panel data of several countries, Dollar & Kraay (2002) in their most cited (and criticised) article "*Growth Is Good for the Poor*"; highlight the role of growth as being the main factor contributing to reduce poverty: "*Average incomes of the poorest fifth of a country on average rise or fall at the same rate as average incomes*". In other words, they find a "one-to-one relationship between growth and incomes of the poor. As the authors point out:

---

[27] Ravallion, M., Chen S. (2003). Measuring Pro-Poor Growth. Economics Letters 78 (2003) 93–99. This measure is based on the ordinary Lorenz curves. This implies that this measure checks for the first order dominance of the income distribution at time t with respect to the distribution at time t-1. It does not provide conclusive results on whether the growth is pro-poor or not in absence of first order dominance.

[28] The PEGR is claimed to be superior to the Ravallion and Chen (2003) estimate of pro-poor growth as PEGR respects the "monotonicity criterion", i.e. for any increase in the index, poverty should fall (and vice-versa). Kakwani N., Son, H. (2003) Pro-poor Growth: Concepts and Measurement with Country Case Studies. The Pakistan Development Review 42 : 4 Part I (Winter 2003) pp. 417–444

[29] Son H., (2004) A Note on Pro-Poor Growth. Economics Letters 82 (2004) 307–314

[30] For a discussion on ordinary Lorenz curves versus Generalized Lorenz curves see for example Bellù and Liberati (2005). Bellù and Liberati (2005): Ranking Income Distributions with Generalised Lorenz Curves. EASYPol series (www.fao.org/easypol) Food and Agriculture Organization of United Nations. Rome.

[31] "*Of 131 spells when growth rates were positive, growth was pro-poor in 55 (23.2%) cases and anti-poor in 76 (32.1%) cases. In 53 out of 106 spells of negative growth rates, the poor suffered proportionally a greater decline in their consumption compared to the non-poor*". Son H., H , Kakwani N. (2008): Global Estimates of Pro-Poor Growth. World Development Vol. 36, No. 6, pp. 1048–1066, 2008

"*evidence does strongly suggest that economic growth and the policies and institutions that support it on average benefit the poorest in society as much as anyone else*". Policy implications are that selected pro-poor policies may be less useful for poverty reduction than general "enabling-environment-oriented" policies because "*... private property rights, stability, and openness contemporaneously create a good environment for poor households (and everyone else) to increase their production and income"*. In addition, there is *"...little evidence that formal democratic institutions or a large degree of government spending on social services systematically affect incomes of the poor*".

Furthermore, Kraay (2004)[32] uses data from several household surveys in less industrialised countries in the eighties and nineties to show that most of the variation of poverty can be attributed to the growth of average incomes.

These results have been used to support the latest wave of thinking, and related policies, conceiving growth as the primary "ingredient" for development, under the belief that growth, even if it accrues for the rich, trickles-down to poor through the normal income distribution channels and the functioning of free markets, favoured in turn by the withdrawal of national governments, the liberalisation of foreign trade and the promotion of foreign investments. This vision configures a sort of "***free market trickle-down growth***" development paradigm, according to which, other development ingredients are of secondary importance.

However, around fifty years earlier Kutznetz (1955), highlighting some still very actual issues, warned that: "*Because they may have proved favourable in the past, it is dangerous to argue that completely free markets, lack of penalties implicit in progressive taxation, and the like are indispensable for the economic growth of the now underdeveloped countries. Under present conditions, the results may be quite the opposite:*
- withdrawal of accumulated assets to relatively "safe" channels, either by flight abroad or into real estate; and
- the inability of governments to serve as basic agents in the kind of capital formation that is indispensable to economic growth.

It is dangerous to argue that, because in the past foreign investment provided capital resources to spark satisfactory economic growth in some of the smaller European countries or in Europe's descendants across the seas, similar effects can be expected today if only the underdeveloped countries can be convinced of the need of a 'favourable climate'."

In addition, even when trickle-down mechanisms work, they don't assure an efficient allocation of resources leaving room for government interventions to redistribute income (Aghion, 1997).[33]

Similarly, among development circles it is currently commonly recognised that; "*The best way to reduce poverty is to provide people with opportunities to earn income through participation in the production process. Therefore, any strategy aimed at defeating food insecurity and poverty in the long run will have to be rooted in sustainable, broad-based economic growth and development"*. (FAO 2006)[34].

[32] Kraay, A. (2004). "When is Growth Pro-Poor? Evidence from a Panel of Countries", The World Bank, Policy Research Working Paper No. 3225.
[33] Aghion, P. Bolton, P. (1997) A Theory of Trickle-down Growth and Development. The review of economic studies, vol. 64, Issue 2 (Apr., 1997), 151-172
[34] Kidane,W, Maetz, M. (2006) Food Security and Agricultural Development in Sub-Saharan Africa: Building a Case for More Public Support. FAO UN policy Assistance Series;

The qualification of growth as "broad-based",[35] is of fundamental importance: only growth processes that include the large majority of individuals and households are assumed to be poverty reducing. However, it is not always clear whether this "broad-based" growth, in order to be considered "pro-poor" has to lead to a reduction of absolute poverty, as measured on the basis of some sort of "absolute" poverty line or, whether it also has to lead to a reduction of the relative poverty, i.e. poverty measured on the basis of some sort of income or expenditure inequality index. This issue is reported in literature as the debate on the definition of "pro-poor growth".

Lopez (2004) summarises the debate, identifying two main positions:

- The first definition of pro-poor growth focuses solely on the link between poverty and growth: growth is pro-poor if it reduces poverty, where poverty is defined on the basis of some absolute criterion[36]. This is the view supported by Ravallion (2004)[37], for example.
- The second definition, as presented in Kakwani and Pernia (2000)[38], qualifies growth as *"pro-poor only if, in the growth process, "the poor benefit proportionally more than the non-poor, i.e. growth results in a re-distribution in favour of the poor*"; explicitly admitting that there may be growth processes that cannot be characterised as "pro-poor even if they generate a reduction of poverty incidence. This means that it is not absolute poverty which matters, but relative poverty.

The definition provided by Kakwani and Pernia, while being more difficult to meet, looks more attractive in the long term as relative income inequality has implications for non-income aspects relevant to well-being, such as the position of each individual (or household) within the society; her/his empowerment, the actual, effective role and functioning of institutions, including the way participation and democracy effectively works. Strong income inequality, may indeed lead to an erosion of the substance of any democratic institution, given the objective disparities of power of the different members of a society. Analysing poverty and informing policy processes by making use of relative rather than absolute poverty, may also help to capture *"...a wider range of factors such as powerlessness, survival, personal dignity, security, self-respect ..."* (Carvalho and White 1997)[39] which are usually taken into account by qualitative rather than quantitative approaches for poverty analysis.

As a concluding remark on the links between growth and poverty reduction, it is worth mentioning the findings of De Janvry and Sadoulet (1998)[40]. After analysing the causal relationships between growth and poverty by means of econometric analysis on a panel of twelve Latin American countries between 1970 and 1994, they conclude that "*Growth only*

[35] The use of the term "broad-based" firstly appeared in the World Development Report 1990: World Bank (1990), Washington D.C.

[36] For a discussion on absolute versus relative poverty, see, e.g. Bellù L.G., Liberati P (2005) Impacts of Policies on Poverty The Definition of Poverty. EASYPol Series (www.fao.org/EASYPol) FAO U.N. Rome.

[37] Ravallion, M. (2004) Pro-poor Growth: A primer. Washington ,D.C.: Development Research Group, The World Bank.

[38] Kakwani N., Pernia E.M., (2000): What is pro-poor growth? Asian Development Review, vol. 18, no. 1, Asian Development Bank.

[39] Carvalho, S., White H. (1997). Combining the Quantitative and Qualitative Approach to Poverty Measurement and Analysis. The Practice and the Potential. World Bank technical paper 366.

[40] De Janvry, A. Sadoulet, E. (1998). Growth, Poverty, and Inequality in Latin America: a causal analysis, 1970-1994. Department of Agricultural and Resource Economics Working Paper no.784. Berkeley, University of California USA.

reduces urban and rural poverty if the initial levels of inequality and poverty are not too high. In the Latin American countries where this is not satisfied, growth is totally ineffective in reducing poverty/inequality". In other words, 'growth' (without any qualifier) is good for poverty (and inequality) only if we do not talk about 'serious' poverty (and inequality).

The position of economists and development institutions viewing growth as an ingredient of development only if associated to a somehow equitable distribution of income, reflect the so-called *"**pro-poor (broad-based or balanced) growth**"* development paradigm. On the basis of the various contributions reviewed above, we can say that, overall, the debate among the supporters of this view has been on how to define and how to measure pro-poor, broad-based, balanced growth and how to achieve it. The debate around the latter point swings between i) the relative weight the promotion of small scale activities, notably smallholder agriculture, agro-processing in rural areas and small scale industrial activities in urban areas; ii) the support of large scale activities, also funded by Foreign Direct Investment (FDI) necessarily associated to strong institutions ensuring appropriate functioning of factor markets and natural resources (capital, labour, land, water, ores, oil etc) to grant decent working conditions and remunerations, non-depletion of the natural resource base and social sustainability also through an efficient fiscal system; and iii) the promotion of social policies, safety nets, direct support to poorest through provision of services (health, education, housing etc.) associated to policies to ensure inclusion, empowerment and self-reliance of the weakest layers of the society.

4. Agricultural growth *versus* economic growth

In an economic system, some sectors play the important role of "engines of growth" more than others. It is commonly recognised that the development of the agricultural sector is particularly important in less industrialised countries to support the general economic growth for different reasons, because it:

- is integrated down-stream as it supplies primary commodities to selected national value chains (agro-industry, textile, and more recently, bio-fuels), thus allowing national value added generation and distribution;
- distributes income to people whose consumption patterns are primarily orientated towards nationally produced commodities, giving rise to multiplier effects;
- produces food for the national market, contributing to food availability at national level, so reducing or zero-ing the need to import these necessary items and contributing to keep food prices acceptably low to feed the labour force in other sectors.
- may provide foreign currency by means of agricultural exports, allowing the import of industrial goods and including capital equipment for the industrial sector;
- is a main source of a low-cost labour force, whenever the technological changes in agriculture induce the release of labour which becomes available to industry and services.
- contributes to generate savings within the economic system which can finance the generation and/or consolidation of the industrial sector.

These arguments are based on findings of a conspicuous mass of studies on agricultural development and growth, carried out over the last sixty years[41].

Just after the Second World War, economists dealing with development issues started consolidating their vision of 'agriculture' (broadly intended as a set of traditional, subsistence and rural activities) as an ancillary sector functional to the development of the more 'modern' industrial sector..

The Nobel laureate Arthur Lewis, in the fifties pioneered the exploration of the industrialisation process of a dualistic economic system, characterised by two sectors: *"subsistence"* sector and *"capitalistic"* sector, with *"unlimited*" supply of labour, flowing from the first to the second:

" In many economies an unlimited supply of labour is available at a subsistence wage.....The main sources from which workers come, as economic development proceeds, are subsistence agriculture, casual labour, petty trade, domestic service, wives and daughters in the household, and the increase of population....In such an economy employment expands in a capitalist sector as capital formation occurs.... Capital formation and technical progress result not in raising wages, but in raising the share of profits in the national income. ....As the capitalist sector expands, profits grow relatively, and an increasing proportion of national income is re-invested.... The capitalist sector cannot expand in these ways indefinitely, since capital accumulation can proceed faster than population can grow. When the surplus is exhausted, wages begin to rise above the subsistence level.... The country is still, however, surrounded by other countries which have surplus labour. Accordingly as soon as its wages begin to rise, mass immigration and the export of capital operate to check the rise. ... The importation of foreign capital does not raise real wages in countries which have surplus labour, unless the capital results in increased productivity in the commodities which they produce for their own consumption. .....Practically all the benefit of increasing efficiency in export industries goes to the foreign consumer; whereas raising efficiency in subsistence food production would automatically make commercial produce dearer" (Arthur Lewis - 1954)[42],.

In the sixties, this "reserve army", concentrated in rural areas (generically referred to as "agriculture" by many authors) inspired the traditional view of the link between agriculture and growth, according to which a "developing" economy is a "dual" system where a "dynamic" industrial sector is associated with a more "traditional" agricultural sector. However, very often, the "traditional sector" was not seen only as a "reservoir" of labour, but more generally as a source of "surpluses" (variously defined as for example, savings, excess labour force, inputs, food etc), to be extracted and put at the service of the "modern" (industrial, urban) sector. Technology and productivity enhancements in the "agricultural" sector allow for the generation of "surpluses" that feed the evolution of the industrial sector. For example Kutznets (1964)[43], in describing the role of agriculture and related policies in such a "dual" system, highlights that it is important to identify ways to extract the agricultural

[41] For a comprehensive treatment of the theory of the growth of the agricultural sector within the context of a growing economy see e.g. : Mundlak**,** Y. (2000). *Agriculture and Economic Growth* Theory and Measurement. Harvard University Press

[42] Lewis, W. A. (1954). 'Economic Development with Unlimited Supplies of Labour', *The Manchester School*, Vol. 22, pp. 139–191.

[43] Kutznets, S. (1964) Economic Growth and the Contribution of Agriculture: Notes for measurement" In C. Eicher and L. Witts: Agriculture in Economic Development. New York. McGraw-Hill.

"surplus" to finance industrial capital formation without hampering the growth pattern of the agricultural sector itself.

Fei and Ranis (1964) [44] proposed a dual-economy model where the economic system goes through subsequent phases of development determined by productivity changes in agriculture: a) in the absence of any technological change in agriculture, labour is in excess supply and its marginal productivity is zero; in this phase labour may be supplied to the industrial sector without any loss of agricultural output; b) technological changes in agriculture improve the marginal productivity of labour so that it becomes positive but less than the real wage. In this case, labour flows to the industrial sector with some loss of agricultural output.

Jorgenson (1967) [45], adopting an analytical framework similar to that of Fei and Ranis, added emphasis to the role of the agricultural surplus as a generator of savings, which in turn allowed capital accumulation and consequent expansion of the economic system. By comparing the "*classical*" approach to the development of a dual economy and the "*neoclassical*" one, he first highlights that: "*the chief difference between these two approaches to the development of a dual economy is in conditions governing the supply of labour to the industrial sector. In the classical approach to the theory [...] labour is available in unlimited amounts at a fixed real wage. In the neo-classical approach labour is never available to the industrial sector without sacrificing agricultural output".* According to Jorgeston, despite the difference regarding the supply of labour, both theories converge on : "*the central fact of economic development is capital accumulation (including knowledge and skills with capital)*". However: "*... Disguised unemployment is neither necessary nor sufficient to generate a sustained rise in the share of saving. Ultimately, a sustained increase in the saving share depends on a positive and growing agricultural surplus and not on the presence or absence of disguised unemployment"*.

Dixit (1970)[46], as a follow-up to the work of Jorgenson, puts forward the idea that in a dual/labour-surplus economy, technical progress as well as capital accumulation in 'agriculture' could allow this labour to become productive. This implies that the level of employment for which the marginal product of labour becomes zero (assuming diminishing productivity of labour) could be moved forward to a point where all the agricultural labour force is productively absorbed. Therefore, technical progress and capital accumulation in agriculture could prevent the decline of agricultural employment and its transfer to the industrial sector. This consideration gives a 'new dignity' to the 'agricultural' sector, which is not perceived any longer as completely ancillary to the rest of the economic system, but as a sector the development of which can contribute to productive job creation and overall well-being, by means of technical progress and capital accumulation. .

The idea of a 'New dignity' to the agricultural sector, intended as 'rural space', was also provided by the work of Harris and Todaro (1970)[47]. In a different conceptual context, characterised by unemployment in the 'modern' sector, these authors developed a dualistic labour market model on the basis of which some paradigms of the relationships between the agricultural and the industrial sectors needed to be revisited. Productivity improvements in the agricultural sector (considered to be rural space) were no longer seen as devices allowing the

[44] Fei, J. C. H., and Ranis, G. (1964), *Development of the Labour Surplus Economy,* Homewood: Irwin, 1964
[45] Jorgenson D., W. (1967) Surplus Agricultural Labour and the Development of a Dual Economy, *Oxford Economic Papers.*1967; 19: 288-312
[46] Dixit, A., (1970): Growth patterns in a dual economy. *Oxford Economic Papers,* 22 (2) July 1970, pp. 229-33.
[47] Harris, J. R., and Todaro, (1970) M . P., 'Migration, Unemployment and Development: a two-sector analysis', *The American Economic Review,* 60 (1) , Mar. 1970, pp. 126-42.

release of labour from agriculture towards the industrial sector, but rather as devices to keep labour in rural areas, thus reducing unemployment in industrial (urban) areas. According to this model, rural areas release labour up to a point where the expectations regarding the wage differentials between rural and urban areas are offset by the probability of falling unemployment in the urban areas. Therefore, a direct policy implication is that promoting the development of activities in rural areas could reduce the wage differentials between rural and urban areas and, by way of consequence, reduce unemployment in the industrial (urban) sector.

Morrison and Thorbecke (1990)[48] provide a rigorous definition of the "agricultural surplus" and a methodology to measure it. They make use of a Social Accounting Matrix framework, where all the accounts (activities/commodities, factors, institutions and Rest of the World) are separated into agriculture and non-agriculture[49]. The net domestic flows of goods and factors from agriculture to non-agriculture are computed, to obtain the "domestic agricultural surplus". Furthermore, the "foreign agricultural surplus", as the difference between exports and imports of agriculture, is calculated. The sum of domestic and foreign surplus constitutes the total surplus. Adopting this definition allows for the measurment of the contributions of agriculture to growth. In addition, it allows for an assessment of the impacts of policies favouring technological changes in agriculture.

Chow (1993)[50], with reference to China, highlights that the development strategy from the beginning of the fifties to the end of the eighties was characterised by capital accumulation at the expense of consumption, essentially by peasants, and promotion of industry at the expense of agriculture. This ***"low-wage industry-led***" development paradigm, which led to investing a large share of national output, especially into heavy industry, generated significant growth rates (around 6% annum) for over almost forty years. In the absence of substantial technological changes in agriculture, this has apparently been an industry-led long-term growth, with prices of agricultural goods growing much faster than the industrial ones, essentially to absorb excess demand for agriculture and excess supply for industry. Apparently, the Chinese case confirms the paradigm that wants "agriculture" as a supplier of "surplus" to the industrial sector. In the absence of significant technological changes in agriculture, this transfer had to occur at the expense of consumption in rural areas. The peculiar institutional settings of China, i.e. autocratic and centrally planned, might have favoured inter-sectoral surplus transfers even if not supported by increased agricultural surplus generation. However, the long term rise of the relative prices of agricultural goods has partially reduced the net transfers from the agricultural sector to the industrial sector.

To assess the role of agriculture in supporting the expansion of industry it is important to capture both physical flows of commodities and services, and changes in relative prices of agricultural goods and services w.r.t. industrial ones, as inter-sectoral transfers of surplus occur both ways, Winters et al (1997) [51]call them "visible" and "invisible" surpluses. The

[48] Morrison C., E. Thorbecke (1990). The concept of Agricultural Surplus. World Development 18 (8) 1081-1095

[49] A Social Accounting Matrix is a summary table of the transactions occurring among productive sectors, domestic "institutions" (households, government, enterprises) and the rest of the world, based on the national accounts. Indeed, the separation adopted, specifically for households, reflects more the geographic location : "urban" and "rural".

[50] Gregory C. Chow (1993): Capital Formation and Economic Growth in China. The Quarterly Journal of Economics, Vol. 108, No. 3 (Aug., 1993), pp. 809-842

[51] Winters, P., De Janvry A., Sadoulet E., Stamoulis K, 1996. The Role Of Agriculture In Economic Development: Visible And Invisible Surplus Transfers Department of resource economics working paper n 143.

authors revisited the SAM approach followed by Morrison and Thorbecke, where construction was based on fixed prices, and adopted a SAM-based CGE approach with flexible prices. Starting with an "archetype" SAM for a "typical" African country developed by Sadoulet et al (1992)[52], a two-sector model was built and used to calculate the change in the "visible" and "invisible" agricultural surplus generated by a 10% increase of total factor productivity. The authors found that, in the base case, the agricultural surplus is small, representing around 0.4 % of the GDP, as in the archetype SAM for Africa (and also in reality), whereas the level of interaction between agriculture and non-agriculture is weak. The 10% increase of agricultural productivity gives rise to a change in the surplus transfer of around 1% of GDP. The relevant finding however is that the "invisible" transfer (via changes in relative prices) exceeds by far (around four times) the "visible" one.

More recently, the causal links between agriculture growth and economic growth has also been emphasized for instance by Tiffin and Irz (2006)[53], who, by means of an econometric model analyse the direction of causality between the agricultural value added per worker and the Gross Domestic Product per capita in a panel of 85 countries. They conclude that, for less-less industrialized countries there is clear evidence that the first "causates" the second.

Furthermore, in the line traced by Johnston and Mellor (1961) [54], Anriquez and Stamoulis (2007) revisited the role of agriculture as an engine of growth providing new evidence to the importance of "backward" and "forward" linkages of the sector. The authors calculate that for a sample of 26 low-middle income countries, backward and forward linkage indexes[55] and emphasise that, in earlier stages of development, agriculture plays an important developmental role thanks to its backward linkages. This opposes the historical view (see e.g. Hirschman, 1958) that denied agricultural development the role of 'engine of growth' due to its weak backward linkages with the rest of the economy[56].

Overall, the role of the agricultural (rural) sector has been perceived alternatively as a passive supplier of low-wage labour to feed the growth of the industrial sector, or as a sector that, if properly managed, can provide income, improve income distribution, generate savings, and export revenue, at the service of the whole economy. In the first case, the primary ingredient of development is the creation of a solid industrial sector with the aim of using in a more efficient way the available endowments. In the second case, the development of the whole

---

[52] Sadoulet E., Subramanian S. and De Janvry A. (1992). Adjusting to a Food Price increase in the context of Stabilization Policies : An Analysis Using Archetype Financial CGE for Developing Countries. Report prepared for the World Bank.

[53] Tiffin R, Irz X, (2006) Is agriculture the engine of growth? Agricultural Economics, 35: 79–89. July 2006.

[54] Johnston B,F and Mellor J,W. (1961): The role of agriculture in economic development, American Economic Review 51(4): 566-593, 1961. Anríquez, G., Stamoulis, K. 2007. Rural development and poverty reduction: Is Agriculture Still a Key? e-JADE, FAO- Rome.

[55] In an Input-Output (I-O) context, as in the one adopted by the authors, "*backward linkages*" are the relationships of a sector with the other sectors via its input requirements; "*forward linkages*" instead refer to relationships of a sector with the others by means of the absorption of the sector's outputs downstream. The authors work out backward and forward linkages of the agricultural sector as first-round multipliers, i.e. "attenuated" Leontief multipliers which rule out second to nth-round effects, on the assumption that these further effects may not be realised due to frictions in the economic system or structural changes occurring during the adjustment process. In addition, these effects are weighted with the relative importance within the economy of the sectors providing the input or adsorbing the output. For more details on these indicators, see Anriquez et al (2003): Anriquez G, Foster, W, Valdéz A (2003): Agricultural Growth linkages and the Sector's Role as Buffer. Roles of Agriculture Project. FAO. Rome

[56] Hirschman, A., O. (1958): The strategy of Economic Development, Yale University Press, New Haven, Connecticut.

socio-economic system is supported by the development of the agricultural sector. This can be seen as an "***Agriculture-based"*** development paradigm.

This paradigm has to be further qualified if agricultural growth has to directly contribute to the various dimensions of socio-economic development. In particular, it has to take into account which type of agriculture, and in which context, directly contributes to poverty reduction and to other development dimensions, beyond its contributions to poverty reduction through impacts on economic growth (see the next section on agricultural growth versus poverty reduction).

In any case, under the Agriculture-based development paradigm, while the agricultural sector plays the role of an engine of development, the industrial sector plays an ancillary role, at least during the "early stages" of the development process. However, most of the supporters of agriculture have always seen the sector as a "temporary" engine, in view of better times, i.e. the next stages of the "development process".

However, whether the concept of "stage" of development is still meaningful or not, is a debatable issue. Even if it is difficult to infer any conclusive judgement, given the quantity and complexity of the contributions provided by many authors on the links between agriculture, industry, economic growth and development, the feeling is that most of the literature moves within the 'growth paradigm', traced by Rostow (1960)[57] where a somehow 'deterministic' path in five "stages" was set out. These five stages are essentially based on the history of western countries, from, "*the traditional society*" to "*the age of mass-consumption*", through "*the pre-conditions to take off*', "*the take off*" and "*the drive to maturity*". Taking for granted the "*five stages",* of growth, almost automatically translated into the five stages of development until recently, technological changes in agriculture (or some surrogate shortcut, as in the case of China), can be seen as "*pre-condition to take off*", which allows the sector to increasingly generate surplus that feeds the industrial sector. These "five stages" can be seen as an "***overarching deterministic development paradigm***" into which fit most of the past and prevailing views of development processes.

5. Technology changes *versus* economic growth.

A further question, still open, is whether these technological changes which are able to generate additional surplus, have to be exogenous, as suggested by Rostow and other supporters of "*technology transfers*", or whether these changes have to be endogenous, i.e. based on domestic investment on knowledge, as suggested e.g. by Romer (1986)[58] and other supporters of the "***endogenous growth-based"*** development paradigm. Romer and Lucas (1988)[59], observing the failure of the expected cross-country convergence, dropped two central assumptions of neoclassical models: i) that technological changes are exogenous; and ii) that the same technological opportunities are available all over the world. This led to the introduction of the so called "Endogenous growth model" where investment not only increases the stock of capital, but generates "spillovers" in such a way that also technological

[57] Rostow W.,W. (1960) The Stages of Economic Growth. A non-communist Manifesto. First Edition. Cambridge University Press.
[58] Romer P., M. (1986). Increasing Returns and Long-Run Growth. The Journal of Political Economy, Vol. 94, No. 5 (Oct., 1986), pp. 1002-1037
[59] Lucas, R. E., Jr., "On the Mechanics of Economic Development," *Journal of Monetary Economics,* July 1988, 22:1, 3-42.

changes occur at the same time, generating further growth. These spillovers may be generated for instance, by "learning-by-doing" processes. Factors typically exhibit increasing returns, as the expansion of the activity levels increases the generation of knowledge, thus leading to technology improvements. Additional endogenous growth models, focusing on endogenous innovations and the temporary monopolistic rents to remunerate innovations and on the role of human capital (Mankin, Romer, Weil, 1992)[60], investigating the extent to which the possibility to benefit monopoly profits motivate innovation progressed and highlighting links between market size, international trade, and growth (Grossman & Helpman, 1989)[61] were also developed[62].

The role of the government is controversial when assuming endogenous technology. On the one hand, public expenditure on research and development contributes to generate new knowledge and support the discovery and application of innovations. Similarly, expenditure to enforce property rights would allow private agents investing in innovations to benefit from their investment, thus stimulating new innovations. On the other hand, excessive levels of taxation may discourage economic activities as would reduce private returns on investment (Barro, 1990)[63].

Implications for development processes of the "***Endogenous Growth-based development paradigm***" are various and possibly controversial. As spill-over effects of investment and/or learning-by-doing processes, by definition exist only if people are investing and/or doing something, this paradigm leaves the unresolved issue of how to start up any growth-based development process. A ready made answer could rely on foreign investment and technology transfers, possibly associated to some degree of international trade. Technology transfers may be useful to start-up production and accumulation processes both in terms of capital and in terms of learning-by-doing knowledge. As paradoxical it could be, endogenous growth-based development processes should rely on exogenous growth-based processes for their start-up, above all in situations where negligible economic activities are going on (for instance, post-conflict, post-emergency situations). However endogenous growth-based approaches raise strong questions on the concept of "technology transfers" per se. Extraneous production modalities, retained or disguised information on know-how by investors, associated to missed control on capital accumulation processes by local actors, for instance, due to stealth expatriation of profits, may hamper the accumulation of capital as well as the endogenous generation of innovations by blocking learning-by-doing dynamics, hampering the empowerment of local actors and jeopardizing the appropriate use of local endowments.

[60] Mankiw, N. Gregory, David Romer, and David N. Weil, "A Contribution to the Empirics of Economic Growth," *Quarterly Journal of Economics,* May 1992, 107, 407-37.
[61] Grossman, G. and Helpman E., "Product Development and International Trade," Journal of Political Economy, December 1989, 97:6, 1261-83
[62] A survey of Endogenous growth models is provided by:
Romer (1994), P. M. The Origins of Endogenous Growth *The Journal of Economic Perspectives*, Vol. 8, No. 1. (Winter, 1994), pp. 3-22.
[63] Barro, R., "Government Spending in a Simple Model of Endogenous Growth," *Journal of Political Economy*, 98, 1990, S103-S125.

6. Agricultural growth and technological changes versus Poverty reduction

The direct link between agricultural growth and economic growth discussed above is still of actual concern, as many less industrialised countries produce large shares of their GDP from within the agricultural sector. However, in the last decade, in the mainstream of the debate on pro-poor growth, the focus shifted somewhat from the direct linkages between agricultural growth and economic growth, to the role of agricultural growth for poverty reduction. From the announcement of the Millennium Development Goals onward, the main question addressed by the 'development community' has been how to promote sustainable, "broad-based" economic growth and development in less industrialised countries to achieve poverty reduction. An ancillary question is to what extent agricultural growth is a good - or even the best - tool to fight poverty. In other words, is agriculture really the most promising sector for the achievement of poverty reduction (and, possibly, eradication)?

To answer this question, several economists have been engaged in exploring links between the growth of the agricultural sector and poverty reduction, mainly using SAM-based multiplier approaches[64], CGE models and econometric analysis of international panel data.

In order to explain the differences in income inequality across countries, Bourgignon and Morrison (1998)[65] carried out some econometric estimates using a sample of 38 less industrialized countries between 1970 and 1985. The authors found that the dualism between agriculture, characterized by low productivity of factors, and the rest of the economy, comparatively more productive, still explains most of the income inequality, concluding that '*in many countries increasing the level of productivity in traditional agriculture may have become the most efficient way of reducing inequality and poverty*".

Thirtle et al (2003)[66], analysed data on 59 countries by means of an econometric model adopted to keep in account the causal chain between agricultural R&D, agricultural productivity growth, GDP per capita, inequality and poverty reduction. The authors found that agricultural productivity growth has a substantial impact on poverty reduction, whereas productivity growth in industry and services does not.

Timmer (1997, 2002, 2003)[67] highlights that the impact of agricultural growth on poverty depends upon the way in which the poor are connected to growth (the so called "elasticity of connection" of poverty to growth) and the way in which a country's income is distributed. "*With highly unequal distributions of income, caused to a substantial extent by highly unequal*

---

[64] Multiplier analysis has been developed by Pyatt, G. and J I Round (1979): Accounting and fixed price multipliers in a SAM framework. Economic Journal , 89 (356): 850-873. An application of a detailed multiplier analysis can be found in: Khan, H.A. (1999). Sectoral growth and poverty alleviation: a multiplier decomposition technique applied to South Africa. *World Development.*

[65] Bourguignon, F., Morrisson, C. (1998). Inequality and Development: the Role of Dualism. Journal of Development Economics 57:2, 33-57.

[66] Thirtle C., Lin L. & Piesse, J, (2003). The Impact of Research-Led Agricultural Productivity Growth on Poverty Reduction in Africa, Asia and Latin America. World Development, Elsevier, vol. 31(12), pages 1959-1975, December.

[67] Timmer, C.P. (1997). How well do the poor connect to the growth process? Cambridge, Mass., USA, Harvard Institute for International Development

Timmer, C.P., (2002). Agriculture and economic development. In: Gardner, B. and Rausser, G.(Eds.), Handbook of Agricultural Economics. Elsevier Science, Amsterdam, North Holland.

Timmer, C.P., (2003) Agriculture and Pro-Poor Growth. The Pro-Poor Economic Growth Research Studies. Boston Institute for Developing Economies.

land ownership, agricultural growth actually seems to exacerbate poverty. By contrast, when a country's income distribution is relatively equal, agricultural growth stimulates the rest of the economy at the same time that it strengthens the connection of the poor to that more rapid growth" (Timmer 2003).

Aghion and Armendariz (2004), reporting the results of Datt and Ravallion (1998) and Todaro and Smith (2003), with reference to India, highlighted the technological changes in agriculture (notably the so-called Green Revolution), which played a fundamental role in poverty reduction.[68]

Byerlee et al. (2005), summarised the findings of twelve country case studies on "*how to operationalize pro-poor growth*", and suggested that agriculture impacts on poverty reduction also by means of generation of direct income, in particular from exports. According to the authors, macro economic and agricultural reforms in the nineties led to a substantial reduction of poverty among crop producers in selected countries such as Vietnam, Uganda, Ghana, Zambia and Burkina Faso, because "*devaluation, removal of export taxes and ... the closing of para-statal marketing boards have substantially improved the incentives for traditional export crops such as coffee and cotton. ... Not surprisingly, farmers producing export crops experienced the fastest pace of poverty reduction*"[69]. However, the authors have to admit the fragility of this channel for poverty reduction, due specifically to international price shocks and their limited geographical impact: "*...poverty levels in Ugandan coffee areas declined by 50 percent between 1992 and 1999 (although they rose again with the collapse of coffee prices in recent years).... The effects on pro-poor growth have often been narrowly confined to areas with suitable agro-climatic conditions and/or access to infrastructure*".

Emphasis on the role of agriculture to reduce poverty has been put by World Bank (2005, 2008)[70]. Others (e.g. FAO 2009) highlight how poverty is positively affected by agricultural development, specifically by productivity shifts due to investment in infrastructure and R&D, leading to the consequent reduction in prices of staple food consumed by the poor[71].

The conventional wisdom on the role of agriculture for poverty reduction is well summarised by Byerlee et al. (2005): "*mass of evidence [is] already available on the central role of increasing agricultural productivity on pro-poor growth, especially in the early stages of development, and especially if productivity growth is transmitted to lower food prices. ... Given widespread household food insecurity, the major challenge in Africa is how to*

[68] Aghion P.,Armendáriz B. (2004) report the findings of Todaro and Smith (2003): "after the green revolution of the late 1960s and early 1970s, agricultural production started increasing at an annual rate of 3%. This was largely due to improvements in agricultural technologies and irrigation systems...". Datt and Ravallion (1998) who, combining data from 24 household sample surveys spanning 35 years with other sources, found that "*higher farm productivity brought both absolute and relative gains to poor rural households*". See:
Aghion P.,Armendáriz B. (2004) A New Growth Approach to Poverty Alleviation. MIMEO Harward University.
Todaro, M, and Smith, S. (2003). Economic Development, Essex, Pearson Education Limited..
Datt G., Ravallion M. (1988). Farm Productivity and Rural Poverty in India, FCND Discussion Paper No. 42 International Food Policy Research Institute. Washington, D.C.

[69] Byerlee et al. (2005), Agriculture, Rural Development, and Pro-poor Growth. Country Experiences in the Post-Reform Era. Pp.20-21. Agriculture and Rural Development Discussion Paper 21 The World Bank Washington D.C.

[70] World Bank (2005): Agricultural growth for the poor: an agenda for development. The International Bank for Reconstruction and Development/The World Bank.
World Bank (2008): World development report 2008: Agriculture for development. International Bank for Reconstruction and Development/ The world Bank. Washington D.C.

[71] FAO 2009: State Of Food and Insecurity (SOFI) 2009. FAO Rome.

stimulate broad-based productivity growth in food staples and sustain overall productivity gains over decades, if the Asian record of poverty reduction is to be repeated".

Agriculture however, in addition to direct income generation accruing to poor is also seen to play an indirect role on poverty reduction through its support to local expenditure on items produced by poor people outside agriculture but living in the same territory. Mellors (2001), with reference to Pakistan, states that: "*The poor in rural areas are heavily concentrated in the rural non-farm sector. They produce non-tradable goods and services. That is, local demand is essential to their growth. It is rising agricultural incomes that provide that growth in local demand. Thus, agriculture's massive impact on poverty is indirect, working through expenditures on the rural non-farm sector*". Analogous findings, mutatis mutandis, are reported by Ryan &Miller (2003) who carry out a CGE-based analysis, for Chile[72]. Furthermore, De Janvry and Sadoulet (2000)[73], based on the analysis of Latin-American countries, highlight that there is no 'one fits all' strategy to reduce poverty, particularly rural poverty, as the rural poor are highly diversified. "*Heterogeneous access to assets, heterogeneous exposure to market failures and to institutional gaps and heterogeneous access to public goods induce income earning strategies that are highly diverse across households*". This in particular, implies that off-farm activities, including migration, generates a complementary income to the agricultural income, which is important for many households, and indeed, for some of them, constitutes a valid exit strategy from poverty[74].

These considerations allow us to identify, beyond agriculture-led development processes, the existence of a "***rural development"*** paradigm, where the accent is put, not only, or not mainly on agriculture *per se*, but on the development of a set of economic relationships among agents living in the same rural space and on the relationship of the rural space with other spaces, whether be they urban, peri-urban or other rural spaces. This refers for instance to "Clusters" where for some historical, technical or economic or cultural reasons homogeneous or closely interlinked activities are implemented. Polices to maintain and enhance these clusters play an important role in the development process (Timpano et al. 2008, European Commission)[75]. Local value chains integrating primary agricultural production, processing and marketing are examples of such clusters. More in general, the rural development paradigm embodies the concept of "territorial development", which, in turn embodies the concept of "community-based development" broadly intended, i.e. not only seen as an intra-community process but a process involving the relationships of a given community with other communities in the national, or even international arena (FAO, 2005)[76].

---

[72] Raúl O'Ryan, Sebastián Miller, 2003. The Role of Agriculture in Poverty Alleviation, Income Distribution and Economic Development: A CGE Analysis for Chile. Roles of Agriculture (ROA) project FAO-UN Rome.

[73] De Janvry A., Sadoulet E. (2000), Rural Poverty in Latin America: Determinants and Exit Paths, Food Policy, 25, 389-409

[74] On the links between agriculture and poverty reduction in a longer term perspective see also Hazell, P. (1999). Agricultural Growth, Poverty Alleviation, and Environmental Sustainability: Having it All, IFPRI, Washington D.C. and Hazell, P. and Haggeblade, S.(1993). Farm/non-farm growth linkages and the welfare of the poor. In: Lipton, M. and van de Gaag, J. (Eds.), Including the poor. The World Bank, Washington, D.C.

[75] Timpano, F. Piva M.(2008) (Editors). Cluster Policies and Local Development. Vita e Pensiero ed. Milano. European Commission (2008) The Concept of Clusters and Cluster Policies and their Role for Competitiveness and Innovation: Main Statistical Results and Lessons Learned. *Commission Staff Working Document SEC (2008)* Europe INNOVA / PRO INNO Europe paper N° 9.

[76] FAO (2005): An approach to rural development: Participatory and Negotiated Territorial Ddevelopment (PNTD). Rural Development Division Food and Agriculture Organization of the United Nations (FAO) April 2005. http://www.fao.org/sd/dim_pe2/docs/pe2_050402d1_en.pdf

7. External factors *versus* growth, poverty, technology and agricultural development

The question why it seems extremely difficult for some countries *to get a seat on the development bus*, i.e. to get out of persistent poverty, extreme inequality, latent or explicit lasting conflicts, diffused food and health insecurity etc, has puzzled economists (and non-economists as well) for many decades. Development (or "non-development") processes do not happen in a "vacuum" but are affected by and intrinsically linked to the environment in which they occur. Therefore, it is wise to wonder how, why and to what extent external factors, and related external shocks, intended as sudden, significant and persistent variations of one or more of these factors affect the development (or under-development) dynamics of selected countries or groups of countries. An associated question is why some economies are more resilient than others to external shocks thus remaining more stably on their growth path.

External factors influencing less industrialised economies are many and diverse and have been considered by different branches of economics, sociology and anthropology literature. All this makes it impossible to provide a comprehensive literature review. Nevertheless, an attempt will be made to focus on selected factors which more or less recently captured the attention of the development community. Among them, we can mention:

- **international trade-related factors**, such as international trade treaties (WTO membership and related clauses and conditions; bilateral trade agreements, regional groupings and associations, custom unions and free trade zones and other treaties and agreements directly influencing international trade), all this influencing the degree of openness or protection of countries;
- **Other international policy frameworks** (e.g.: international agreements constituting frameworks for national policies, such as MDGs, the "*Right to food*" convention, other human rights and international juridical engagements)[77];
- **Immigration, emigration and remittances,** influencing income-saving levels of zones of origin and destination, the overall macro-economic performances of origin countries in the short medium run and demography in the medium/long run
- **Foreign Direct Investment** (FDI);
- **Official Development Assistance** (ODA);
- **Global macro-economic cycle,** influencing all the above factors through e.g. shifts in the demand of commodities or foreign labour, changes in the level of ODA and/or FDI etc.
- **International financial and monetary agreements** (Rules and regulations related to international financial transactions, borrowing, lending, monetary stability etc.);
- **Natural resource management agreements** (e.g. international watershed management and water use agreements);
- **Natural hazards** (such as floods, droughts, trans-boundary pests and diseases).

The implications, scope, short and long-term consequences of all the above-mentioned factors on national socio-economic systems are determined by: i) the "state" of each specific country, both in the short-medium term (e.g. the potential volume of its international trade, quantity and quality of human and physical capital available, availability of natural resources) and in the long-term (e.g. geographic position, natural hazards etc.); and ii) the interactions occurring between domestic and international (foreign) actors.

[77] On the importance of global policy frameworks for national development and national policy making processes see e.g. Cistulli (2007). Cistulli V. (2007): The Global Policy Environment: a Conceptual Framework . EASYPol series n. 99 FAO UN – Rome. www.fao.org/easypol

Countries carry out domestic production/consumption activities and trade with their partners under the influence of the above mentioned factors. Indeed, these factors, together with a multitude of other domestic factors, such as: the economic behaviour of domestic agents (producers and consumers) ; the role played by the government; the degree of integration and homogeneity of the society; the state of infrastructures; the degree, effectiveness and enforceability of domestic legislation etc, all contribute to shape the performance of an economic system in the short, medium and long term.

The links between internal and external factors in determining the performance of an economic system have been analysed from different perspectives in different periods. Following Gore (2000)[78] "*Before the propagation of the Washington Consensus in the 1980s, mainstream explanations of the development process [...] were conducted within a national frame of reference [...] (and) economic and social trends within countries were explained, in the mainstream on the basis of conditions within countries themselves, i.e. as a result of national factors* ". The author, however, highlights that an important counter current came from the "structuralists" (particularly in Latin America), which focused on the importance of "centre-periphery" relations and the links between internal and external factors.

Structuralist economics originated within the Economic Commission for Latin America (ECLA) in the early fifties by the works of its director Raul Prebisch (1950)[79]. Less industrialised countries have to rely on imports to get industrial, manufactured goods or services; such as capital equipment, domestic appliances, office equipment, cars etc. To countervail imports of manufactured goods and services they tend to specialise in one or a few export commodities, usually agricultural crops, but also other primary commodities like timber or ores. Prebisch argued that different sets of goods are produced by less industrialised countries with respect to the industrialised ones. The weak institutions and low bargaining power in less-industrialized countries do not allow for starting up the process of accumulation of primary capital and the consequent development process. The so called "*Prebisch-Singer hypothesis*"[80], based on these considerations, argued that the degradation of terms of trade due to the different income elasticities of the two sets of goods, other things being equal, would progressively impoverish less industrialised countries to the advantage of the industrialized ones. This implies that countries should adopt a strategic behaviour towards the achievement of national objectives, using a mix of policies comprising selective openings associated with protective measures in sensitive areas (e.g. infant industry, minimum food stocks etc).

Since the 1980s, a radically different vision of the links between internal and external factors was adopted by economists adhering to the so called "Washington consensus", as defined by Williamson (1990)[81]. It was advocated and supported from the 1980s to the early 2000s in

[78] Gore (2000): The rise and fall of the Washington Consensus as a Paradigm for Developing Countries. World Development Vol 28 No 5 pp 789-804, 2000

[79] Prebisch R (1950). The Economic Development of Latin America and its Principal Problems. United Nations Dept. of Economic Affairs, 1950.

[80] For the work of Singer on trade and investment linkages and terms of trade see: Singer (1950) and Singer (1998).

Singer, H. W. (1950) The distribution of gains between investing and borrowing countries. *American Economic Review, Papers and Proceedings* 40 (2 (May), 473-485

Singer (1998) The terms of trade fifty years late: convergence and divergence South Letter No. 30, Volume 1, 1998 The south centre *http://www.southcentre.org*

[81] Williamson (1990) defined a package of policy measures, specifically suitable for Latin American countries facing economic crises, comprising: 1) Fiscal discipline; 2)A redirection of public expenditure priorities towards

various forms and degrees by almost all bilateral and multilateral development agencies. In particular, the prescriptions related to trade liberalisation, conceptually rooted in the Ricardian comparative advantage (Ricardo, 1817)[82], and liberalisation of inflows of Foreign Direct Investment (FDI), put a direct focus on the importance for an economic system to be "contaminated" by external factors. These would have to affect both capital accumulation processes (the FDI) and the sources and destination of goods and services, to be purchased or sold also on external markets. For instance, Josling (1998)[83] advocated for trade liberalization in agriculture as a way to reduce foodstuff costs and improve the allocation of scarce resources, Krueger (2001)[84] criticized import substitution strategies and emphasize the importance of international trade for economic development, Berg and Krueger (2003)[85] claimed that there is a strong positive relationship between openness to international trade and growth.

According to the ***"Washington Consensus"*** development paradigm, international markets would always be available to absorb exports and provide imports at prices independent from the quantities of commodities traded. This applies in particular to "small countries", which are typically price-takers as the volumes of commodities absorbed by or provided to foreign partners are negligible in respect of the total volumes traded on the international markets. In addition, foreign investment would complement domestic savings and would bring with it new 'modern' technologies, to the benefit of the less industrialised economies. Countries that adjust their domestic policies accordingly and enter the global arena would benefit from the new 'globalised' environment. Others which do not adjust would be marginalised from the 'development' mainstream (Dollar and Kraay, 2004)[86].

Whether less industrialised countries should adhere to the 'Washington consensus' paradigm, somewhat revised in the later years to accommodate some social concerns, or should adopt other approaches based on 'structuralist' analysis, is an open question among development economists. Pingali (2006)[87] for example, attempts a nuanced answer to the question above. He browses some likely impacts of globalisation on agriculture, taking into account some relatively recent phenomena such as increased vertical integration, changing food production systems and technologies and the role of supermarkets. He adopts a (quite deterministic) tri-partite classification of countries, i.e.: *i) countries at the low end of the transformation process; ii) countries in the process of agricultural modernization; iii) countries at the high end of the transformation process,* and for each of the groups identifies some challenges and

---

fields offering both high economic returns and the potential to improve income distribution, such as primary health care, primary education, and infrastructure. 3) Tax reform (to lower marginal rates and broaden the tax base); 4) Interest rate liberalisation; 5) A competitive exchange rate; 6) Trade liberalisation; 7) Liberalisation of FDI inflows; 8) Privatisation. 9) Deregulation (in the sense of abolishing barriers to entry and exit). 10) Secure property rights.
Williamson, J. (1990), "What Washington Means by Policy Reform", in J. Williamson, ed., Latin American Adjustment: How Much Has Happened? (Washington: Institute for International Economics).

[82] Ricardo D. (1817): On the Principles of Political Economy and Taxation. http://www.econlib.org/library/Ricardo/ricP.html

[83] Josling T. (1998): Agricultural trade policy: completing the reform. Policy analyses in international economics, 53. Institute for International Economics. Washington D.C.

[84] Krueger, A. (1998), Why Trade Liberalisation is Good for Growth. The Economic Journal, 108: 1513–1522.

[85] Berg A., Krueger A., (2003): Trade growth and Poverty: a selective survey, in: Annual conference on development economics: the new development agenda. Edited by Pleskovic B. and Stern N..International Bank for Reconstruction /World Bank. Washington D.C.

[86] Dollar, D., Kraay, A. (2004), Trade, Growth, and Poverty. The Economic Journal, 114: F22–F49.

[87] Pingali P. (2006) Agricultural Growth and Economic Development: a view through the globalization lens. FAO- Rome

opportunities, concluding that: "*trade liberalization and global inter-connectedness poses new opportunities and challenges for developing countries*...[but]... *the transition will be pro-poor to the extent that production and post harvest activities continue to be labour intensive and to the extent that there is an expansion in employment opportunities outside agriculture"*. In addition*, "trade liberalization should go hand in hand with public support for improving agriculture productivity"*.

Regarding the FDI, issues arise on how to retain the surplus generated by national economies in order to feed their development process in a globalised environment characterised by strong interdependencies, but also by deep asymmetries (know-how, technology, market power, human capital endowment etc). The strength of national institutions is a key factor enabling less-industrialised countries to retain a satisfactory share of value added and other 'spill-over benefits' (Romer, 1986) generated by foreign-led companies. OECD (2002)[88], in a report prepared within the framework of the activities of the "*Committee on International Investment and Multinational Enterprises (CIME)",* after placing a lot of emphasis on the benefits of FDI, admit that *"Potential drawbacks include a deterioration of the balance of payments as profits are repatriated (albeit often offset by incoming FDI), a lack of positive linkages with local communities, the potentially harmful environmental impact of FDI, especially in the extractive and heavy industries, social disruptions of accelerated commercialisation in less developed countries, and the effects on competition in national markets. Moreover, some host country authorities perceive an increasing dependence on internationally operating enterprises as representing a loss of political sovereignty*". It is apparent that these drawbacks look even more severe in the absence of enforceable labour market regulations and trade unions, ability to set and maintain decent wage levels, and other civil society active components. These issues are also particularly relevant in the context of the recent wave of "land grabbing" in less industrialised countries by foreign investors and sovereign funds, on which FAO called for a '*binding code of conduct*' (FAO, 2009)[89].

The relevance of FDI for national development should also be assessed in the light of the different strategies that foreign investors may adopt to expatriate earnings, by bypassing, or even violating, national legislations. Brealey and Myers (1991)[90], in their manual "*Principles of Corporate finance*", suggest some strategies: *"...Multinational companies are always exposed to the criticism that they siphon funds out of countries in which they do business, and therefore, governments are tempted to limit their freedom to repatriate profits [...]. Here, once again, a little forethought can help. For example, there are often more onerous restrictions on the payments of dividends to the parent than on the payment of interest or principal on debt. So, it may be better for the parent to put up part of the funds in the form of a loan. Royalty payments and management fees are less politically sensitive than dividends, particularly if they are levied equally on all the foreign operations". Last but not least, "A company can also, within limits, alter the price of goods that are bought or sold within the group and can require more or less prompt payment for such sales*".

More in general, some authors tend to de-emphasise the importance of international links for the economic performance of economic systems, attributing more importance to domestic

[88] OECD (2002): Foreign Direct Investment for Development: Maximizing Benefits, Minimizing Costs. Paris, 2002

[89] FAO (2009): From Land Grab to Win-Win. Economic and social perspectives. Policy brief 4, June 2009 FAO – Rome.

[90] Brealey R.A. and Myers S.C: (1991) Principles of corporate Finance, Fourth Edition (p. 880) Mc Graw Hill.

factors. For example, Stiglitz (1998)[91] claims that successful development is more a matter of designing development strategies which embody a holistic vision of the transformation of the whole society, which goes well beyond the Washington Consensus or other specific recipes addressing specific aspects of socio-economic systems, e.g. greater or lesser role of the government, greater or lesser openness to international trade, greater or lesser functioning of markets, balancing macro-economic imbalances etc. While there is no doubt that each of these aspects is important per se, focusing on one or few of these aspects may not lead to appreciable successes in development, unless a consistent, coherent and complete "*vision of the future combined with a framework for realizing that vision*" is designed. In this framework, emphasis is put on elements of social and organizational capital such as: social cohesion, consensus on common goals, inclusiveness, and appropriate institutions enabling the societies to achieve all the above. Acemoglu et al. (2001)[92] underline the importance of domestic institutions in less-industrialized countries to steer development processes, and, specifically, to generate per capita income growth. Rodrik (1999)[93], by means of some econometric work, analyses the dynamics of growth of several countries since 1975, trying to identify the determinants of economic performances. The author emphasises, in particular, the manner in which social conflicts interact with external shock on the one hand, and the domestic institutions of conflict-management on the other. The idea is that "divided" societies, i.e. societies characterised by domestic dichotomies (ethnical, religious, social etc) insufficiently endowed with instruments for conflict management and resolution, are less resilient than others to external shocks, thus showing more erratic growth paths[94].

Rodriguez and Rodrik (2001)[95] take a critical view of the massive evidence, provided in the trade literature, on the positive correlation between openness to international trade and growth. They question the variables used as proxies for trade openness and the quality of the analyses on which this evidence is based. The importance assigned to trade openness as a growth-determining factor is also related to the approaches used to investigate the link between these two variables. For instance, Taylor (2006)[96] criticizes most of the CGE modelling efforts of prominent international organizations advocating more openness to promote growth as they adopt self-fulfilling approaches, i.e. analytical methods designed to provide the "right" answers.

Raddaz (2007)[97] followed a comprehensive approach, going beyond the considerations of terms of trade only, and found that external shocks, namely terms-of-trade variations, natural disasters and the international economic cycle[98] explain only a small fraction of performance

[91] Stiglitz, J. (1998) Towards a New Paradigm for Development: Strategies, Policies, and Processes. Prebisch lecture at UNCTAD, Geneva October 19, 1998.
[92] Acemoglu D., Johnson S., Robinson J.A., (2001): The Colonial Origins of Comparative Development: An Empirical Investigation. The American economic Review. December 2001
[93] Rodrik, D. (1999). Where Did All the Growth Go? External Shocks, Social Conflict, and Growth Collapses Journal of Economic Growth Volume 4, Number 4 / December, 1999.
[94] However the open question to this regard is to what extent domestic dichotomies, or at least their dramatic consequences on welfare in periods of crisis, could be considered endogenous tout court.
[95] Rodriguez F., Rodrik D. (2001): Trade Policy and Economic Growth: A Skeptic's Guide to the Cross-National Evidence . NBER Macroeconomics Annual 2000, Volume 15.
[96] Taylor L, Arnim von R. (2006): Modeling the impact of trade liberalization. A critique of computable general equilibrium models. Oxfam research report July 2006.
[97] Raddaz C. (2007) Are external shocks responsible for the instability of output in low-income countries? Journal of Development Economics 84 (2007) 155–187.
[98] The international cycle is measured on the basis of variations of the aggregated GDP of industrialized countries. Some counter-evidence on the importance of the international economic cycle can be found in FAO (2009), where emphasis is put on the role of remittances as a support to household incomes in rural areas.

variability of Low-Income countries. However Raddaz himself reports that Kose and Riezman (2001)[99], using calibrated general equilibrium small-open-economy models (CGEs) instead of econometric approaches, found that compared with interest rates and productivity shocks, terms-of-trade shocks can explain a large fraction (around 50%) of output fluctuations in low-income countries. This seems to suggest that CGEs better allow highlighting the relationship between terms of trade and country performance.

An additional consequence of the observed limitations and drawbacks of the "Washington consensus" has been the surge of the microeconomic focus of development processes. Increasing attention, beyond global issues such as climate change and global energy constraints, has been paid both in the literature and in the development practice to individual or household behaviour. This has given rise for instance to the surge of experimental studies in development economics (Banerjee and Duflo)[100], a possibly increased emphasis on houseold-focused short-term interventions to the detriment of longer term vision and plans by donors and international agencies, a piece-meal, bottom-up approach to development issues (the development "Searchers" as opposed to the "Planners" in Easterly, 2006)[101]. To some extent, this micro-focused approach to development could be seen as a way of promoting development by directly providing "functionings" and improving "capabilities" of individuals, i.e. promoting development by increasing individual "freedom" (Sen, 1999)[102].

In alternative, this emerging micro-focused approach could be seen as a way to avoid the troubles one would face in attempting to fix the macro-structural imbalances of the global economic system, as were highlighted for instance, by Prebisch. However, to a different degree, many authors, even if not always supporting the Prebisch-Singer hypothesis as literally intended, recognize that in the globalized economic world there are asymmetries, international markets are far from being competitive and emphasise the risks and drawbacks of commodity-dependent peripheral countries. Implicitly or explicitly some of them support a more "strategic" approach to development, say a sort of ***"strategic openness"*** development paradigm, balancing openness and protection differentiating across commodities, partners, periods etc, rather than a simple and blind adherence to the 'Washington consensus' approach. For example, Gilbert (2006) [103] considers that; "*Relative to price of manufactured goods, primary commodity prices have exhibited a variable but steady downward trend over the past century"*. In addition he reports that Grilli and Yang (1988)[104] documented the long term decline of primary commodity prices and shows a graph where the deflated IMF commodity index displays a 1.33% decline per annum between 1960 to 2003. After analysing price trends and volatility jointly, he concludes that " *the adverse price trend experienced by almost all the agricultural primary commodities [...] is problematic for primary producing developing countries because, with inelastic demand and elastic supply, the incidence of*

[99] Kose, M., Riezman, R., 2001. Trade shocks and macroeconomic fluctuations in Africa. Journal of Development Economics 65, 55–80.

[100] Banerjee A.V., Duflo E (2008): The Experimental Approach to Development Economics Massachusetts Institute of technology, Department of Economics. MIMEO. September 2008. http://econ-www.mit.edu/files/3158.

[101] Easterly W. (2006): The white man's burden: why the West's approach to aid the rest has done so much hill and so little good. Penguin Press, New York.

[102] Sen A., (1999): Development as Freedom. Alfred A. Knopf, New York, 1999.

[103] Gilbert C. L. (2006). Trends and volatility in Agricultural Commodity Prices. In "Agricultural Commodity markets and Trade: Analyzing Market Structure and Instability". Edited by A Sarris and D. Hallam. FAO UN-Edward Elgar 2006.

[104] Grilli E.R. and Yang M.C. (1988): Primary commodity prices, manufactured goods prices and the terms of trade of developing countries: what the long run shows. World Bank Economic Review , 2, 1-47.

productivity advance is very largely on consumers, typically in developed countries. Collectively, developing countries have little incentive to undertake productivity-enhancing investments [...]. The result is that developing country farmers are forced to run fast in order to remain at the same place. Liberalization programmes, often sponsored by bilateral and multi-lateral development agencies have accelerated this process".

Also Cashin and Mc Dermot (2006)[105], analyse the secular trends of commodities. While refraining from any conclusive judgement about the validity of the Prebisch-Singer hypothesis, notably about the existence of any permanent downward trends in commodity prices, they conclude that, in any case, "*the long lasting variability of commodity prices is problematic, because 'many developing countries continue to rely on a few commodities for the lion's share of their export earnings. Therefore, a high degree of variability in commodity prices has serious consequences for commodity dependent countries. In particular, shifts in commodity prices are typically reflected in the terms of trade, real incomes and fiscal positions of commodity dependent countries*". Small countries having, by definition, no power on the markets of the main commodities internationally traded, are assumed to be particularly vulnerable to external shocks, in particular to shocks directly affecting those markets, such as shortages or sudden price increases in import markets or decreases in export ones.
These considerations are summarized by Stiglitz (2006)[106]: "*...There are some circumstances in which trade liberalisation brings enormous benefits –when there are good risk markets, when there is full employment, when an economy is mature. But none of these conditions are satisfied in developing countries. With full employment, a worker who loses his job to new imports quickly finds another; and the movement from low-productivity protected sectors to high-productivity export sectors leads to growth and increased wages. But if there is high unemployment, a worker who loses his job may remain unemployed. A move from a low-productivity, protected sector to the unemployment pool does not increase growth, but it does increase poverty. Liberalisation can expose countries to enormous risks, and poor countries – and especially the poor people in those countries – are ill equipped to cope with those risks. Perhaps most importantly, successful development means going from stagnant traditional sectors with low productivity to more modern sectors with faster increases in productivity. But without protection, developing countries cannot compete in the modern sector. They are condemned to remain in the low growth part of the global economy. South Korea understood this. Thirty-five years ago, those who advocated free trade essentially told Korea to stick with rice farming. But Korea knew that even if it were successful in improving productivity in rice farming, it would be a poor country. It had to industrialise...*"

The vulnerability of "small" countries to natural disasters, terms-of –trade shocks and other adverse shocks is accentuated when they are "low" or "lower-middle" income countries[107] (World Bank, 2004)[108]. Among these countries, "Low-Income Food Deficit Countries"

[105] Cashin P.and Mc Dermot C.J, (2006). Properties of international commodity prices: identifying trends, cycles and shocks. In "Agricultural Commodity markets and Trade: Analyzing Market Structure and Instability". Edited by A Sarris and D. Hallam. FAO UN-Edward Elgar 2006.
[106] Stiglitz J. (2006): Social justice and global trade. Social Europe the journal of the European left. Autumn 2006
[107] As classified by the World Bank (Atlas methodology), i.e. countries with a per capita Gross National Income (GNP) less than $ 3,595 (classification 2008, based on 2006 data). See: http://siteresources.worldbank.org/DATASTATISTICS/Resources/OGHIST.xls
[108] World Bank (2004): Global monitoring report. Policies and Actions for Achieving the Millennium Development Goals and Related Outcomes. World Bank, Washington, D.C.

(LIFDC), as classified by FAO UN[109] look even more vulnerable. These countries are considered particularly sensitive on food security grounds as their capacity to access food is directly dependent upon many factors such as: a) prices of food commodities on the international markets; b) prices of main export commodities on the international markets; c) macro-economic stability, including equilibrium of the balance of trade; d) efficiency of logistic facilities and other infrastructes (transport, storage, distribution facilities etc); e) flexibility/resilience of domestic food sector to absorb or adapt to external shocks.

Flexibility and resilience of the domestic food sector and medium-long term equilibrium of the trade balance, are more difficult to achieve by those LIFDC which rely on imports for a significant part of their energy needs. Resilience of the food sector is based on the capacity of the country to expand imports whenever the domestic production is deficient. However, Soaring oil and gas prices impose an additional burden both on the trade balance, through increased oil bills, and on the household budgets through increased food prices due to the increase of imported inputs. This implies that, if a food deficit materializes in association to a rise of international oil and gas prices, little or no margins are left to complement domestic food output with imported food items. Therefore, for LIFDC net energy importers, external shocks on main import-export markets may lead to a significant and sudden worsening of the terms of trade with significant consequences in terms of macro-economic stability and welfare of the population. The international community has recently attributed great importance to external shocks as factors affecting the welfare of populations, due to "soaring food prices" in 2007-2008 and 2011. These crises are assumed to have heavily worsened poverty and food security in LIFDC [110].

Much less emphasis, at least in terms of its impacts on development perspectives and welfare of LIFDC, was put on the soaring prices of energy (oil in particular) from 2003 to 2008. However, while net oil exporting countries experienced huge windfall profits in respect of the 2003 base price, as reported by Bellù (2008)[111], net importing countries had to afford additional oil bills, ranging between 1 % of their GDP in 2006 for most OECD countries up to almost 5% for selected LIFDCs. More than likely, these additional energy bills generated persistent macro-economic instability, decreased overall welfare of the population, increased poverty and hampered their long term development perspectives.

---

[109] FAO UN classifies as "*Low-Income Food Deficit Countries (LIFDC)"* those countries: a) classified by the World Bank as "International Development Agency (IDA) eligible and 20 years IBRD loans" (Operational Lending Category II, i.e. per capita GNI less than 1,735 US$. Classification 2008 based on 2006 data); b) net (i.e. gross imports less gross exports) food trade position of a country averaged over the preceding three years. Trade volumes for a broad basket of basic foodstuffs (cereals, roots and tubers, pulses, oilseeds and oils other than tree crop oils, meat and dairy products) are converted and aggregated by the calorie content of individual commodities; c) Self-exclusion criterion (countries that meet the above two criteria but request to be excluded from the LIFDC category. See http://www.fao.org/countryprofiles/lifdc.asp

[110] The FAO UN, in partnership with other organisations, launched in December 2007 the "Initiative for Soaring Food Prices" (ISFP), aimed at reducing food insecurity generated in LIFDC by increasing food prices. See (FAO, 2008), Initiative for Soaring Food Prices: programme document, May 2008 FAO UN –Rome. (http://www.fao.org/isfp/isfp-home/en/) The ISFP sustained, among other things, the "Emergency Rice Initiative" in 11 countries in West Africa: Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Liberia, Mali, Mauritania, Nigeria, Senegal, Sierra Leone and Togo, aimed at "significantly increase their rice production as of 2008 and 2009," (see Africa Rice Center (WARDA) www.warda.org.)

[111] Bellù (2008) reports that windfall profits in 2006 for example amounted to almost 16 % of GDP for Cameroon, 22% for Nigeria, 25% for Angola, 28% for Chad, up to almost 50% for Equatorial Guinea.

Bellù L.G. (2008): Windfall Oil Profits and Oil Bills: Some Policy Implications for Sustainable Development. MIMEO.

The considerations put forward above regarding the position of different countries with respect to the rest of the world, suggests that the development potential and possibly the development paradigm adopted or adoptable varies according to the features of the countries. Most oil-mineral-timber endowed countries have enjoyed and are still currently enjoying the possibility of accumulating financial resources to start-up and feed development processes through the export of primary resources. This "***primary-resource export-led"*** development paradigm, adopted for instance by most oil producing countries, particularly in the Middle East and Africa, however appears to have some drawbacks. The export of primary commodities as been often associated to the "Dutch disease" problem (The Economist, 1977; Corden and Neary, 1982) [112], i.e. the real appreciation of the domestic currency due to the high foreign currency inflow inside, not permitting the development of other export sectors which are not competitive given the high exchange rate. Such phenomenon has negative effects on development, particularly in the medium-long run (Collier and Goderis, 2009)[113] and implies a missed opportunity of a labour-intensive export-led development of countries mostly relying on the export of natural resources, see: (Sachs and Warner, 2001)[114]. In addition, in absence of appropriate mechanisms of "checks and balances" natural resource-based economic systems provide a fertile ground for rent-seeking behaviours, detrimental to the instauration of good governance practices (Collier and Hoeffler, 2009)[115].

The above-mentioned export-led development, indeed, contrasts with a type of development based on the export of low-wage labour-intensive (manufactured) commodities, such as China (as described in Chow, 1993) i.e. a "***low-wage labour-intensive export-led"*** development paradigm. These latter development paradigms are often associated to a process of ***"import substitution" industrialization***.

A possibly intermediate export-oriented development paradigm is one adopted by countries which are neither endowed with exportable primary resources nor with any significant industrial system. This is the case of countries producing and exporting mainly primary or semi-processed agricultural "tropical" commodities (tea, coffee, cocoa, cotton, bananas etc). These countries base their development on an ***"agricultural commodity export-led***" development paradigm. In addition, countries with a weak industrial sector may find themselves with excess labour because the primary sector is not capable to absorb all the existing labour force even at subsistence wage levels, due to the lack of complementary factors (e.g. capital, infrastructures) and/or natural resources (land, water etc). Therefore, they may adopt an "***Emigration-based"*** development paradigm, essentially based on consumption/accumulation mechanisms driven by remittances of the expatriated. Conversely, other countries which are able to attract labour thanks to their endowments (oil, minerals, land etc) may further develop by adopting an "***Immigration-based***" development paradigm.

A further consideration applies to financial sources that may be used to fund capital accumulation to start up and feed development processes. Further to funds from exports,

---

[112] The Economist (1977): The Dutch Disease. November 26, 1977. pp. 82-83.
Corden, W. M., Neary, J. P. (1982): Booming sector and Dutch disease economics: a survey. Economic Journal, Vol 92.

[113] Collier P. Goderis B. (2009): Commodity Prices, Growth, and the Natural Resource Curse: Reconciling a Conundrum. Department of Economics, University of Oxford.

[114] Sachs, J. D., Warner, A. M (2001) The curse of natural resources, European Economic Review, Volume 45, Issues 4-6, May 2001, Pages 827-838.

[115] Collier, P., Hoeffler A.,(2009): Testing the Neocon Agenda: Democracy in Resource-Rich Societies," *European Economic Review* 53 (2009), 293-308.

selected countries heavily rely on FDI, adhering to a sort of ***"FDI-based"*** development paradigm. Others instead have to rely on a ***"foreign aid-based"*** development, whenever foreign aid is not fully absorbed by immediate emergency-related consumption of subsistence goods (e.g. staple food), it is actually spent to fund development (Easterly, 2008) and it is actually effective to support it (Easterly, 2006) [116].

8. Development paradigms identified

The review of the literature on the ingredients of development and on selected mutual relationships allowed this study to identify a number of possible development paradigms with the following summary features:

- ***Free-market Trickle-down Growth-led*** development. Under this paradigm, growth, even if it accrues to rich, trickles-down to poor through the normal income distribution channels and the functioning of free markets, associated to the withdrawal of national governments, the liberalisation of foreign trade and the promotion of foreign investments.

- ***Pro-poor (broad-based or balanced) growth-led*** development**.** Growth matters for development only if associated to an equitable distribution of income, to be achieved through the promotion of activities generating a broad-based primary income distribution and institutional mechanisms (e.g. fiscal systems) ensuring an equitable secondary distribution of real income, without necessarily relying on trickle-down mechanisms.

- ***Low-wage industry-led*** development. This model is characterised by capital accumulation especially for the promotion of heavy industry, at least in a first stage, which leads to investing a large share of national output and compressing consumption, thus extracting the surplus from labour. In many situations this has occurred or occurs essentially at the expense of the rural poor who migrate to urban areas.

- ***Low-wage labour-intensive export-led*** development. This type of development is based on the export of labour-intensive manufactured commodities in a context low-wage. It is a variant of the previous paradigm where the focus is placed on export-oriented industrialization (The case of China as described in Chow,1993 could fit into this category). These latter development paradigms are often associated to a process of *"import substitution" industrialization*.

- ***Agriculture-based"*** development. Agricultural growth is seen as directly contributing to the various dimensions of socio-economic development, not only through its contributions to the general growth of the economic system but also for its specific contributions to poverty reduction (in its small-scale version), resilience of local communities, preservation of the environment etc.

[116] Easterly W., Pfutze T.(2008): Where Does the Money Go? Best and Worst Practices in Foreign Aid. Journal of Economic Perspectives—Volume 22, Number 2—Spring 2008.
Easterly W., (2006): Reliving the 50s: the Big Push, Poverty Traps, and Takeoffs in Economic Development. MIMEO http://williameasterly.files.wordpress.com/2010/08/48_easterly_relivingthe50s_prp.pdf.

- ***Endogenous growth-based*** development. Technological changes required to support economic growth and by way of consequence development don't need to be "exogenous", i.e. generated from outside national socio-economic systems and "transferred". Investment and activities generate "spillovers" e.g. by "learning-by-doing" processes generating knowledge, thus technology improvements. Emphasis is placed on policies favouring local processes, context-specific technologies and the creation and maintenance of human capital.

- ***Rural development*** paradigm. Here the accent is placed, not only, or not mainly on agriculture or any other sector *per se*, but on the socio-economic relationships among agents present in the same rural space and also on the relationship of the rural space as regards other spaces, whether be they urban, peri-urban or rural. This concept of development fits into the frame of "territorial development" and embodies the concept of "community-based development". Polices to maintain and enhance the above-mentioned relationships play a key role in the development process.

- ***Washington Consensus-based*** development. Development is only possible if countries are able to benefit from the 'globalised' environment. They have to liberalize foreign trade, privatize public assets, lower marginal tax rates and broaden the tax base; keep tight public deficits, refrain from market interventions, liberalize exchange and interest rates, allow free FDI. This will complement domestic savings and bring new 'modern' technologies. Countries which do not adjust their policies accordingly are most likely marginalised from the 'development' mainstream.

- ***Strategic openness-based*** development. Balancing openness and protection by differentiating across commodities, partners, periods etc., rather than simply and blindly adhering to the 'Washington consensus'. This implies for example the protection of infant industry, of strategic sectors including food producing ones, preferential trade agreements with selected countries with complementary economies etc, building comparative advantages on selected commodities also through direct public interventions etc.

- ***Exhaustible-resource export-led*** development. Most oil-mineral-timber endowed countries have enjoyed and are still currently enjoying the possibility of accumulating financial resources to start-up and feed development processes through the export of primary resources. This is the type pf development path adopted for instance by most oil producing countries, particularly in the Middle East and Africa.

- ***Agricultural commodity export-led***" development. This export-oriented development paradigm is often adopted by countries which are neither endowed with exportable primary resources nor with any significant industrial system. This is the case of countries producing and exporting mainly primary or semi-processed agricultural "tropical" commodities (tea, coffee, cocoa, cotton, bananas etc).

- ***Emigration-based*** development. Countries with a weak industrial sector may find themselves with excess labour because the primary sector is not capable to absorb all the existing labour force even at subsistence wage levels, due to the lack of complementary factors (e.g. capital, infrastructures) and/or natural resources (land, water etc). Their development (including their social stability) is substantially based

on consumption/accumulation mechanisms driven by remittances of expatriated workers.

- ***Immigration-based*** development. Countries able to attract labour thanks to financial resources accumulated through the export of their natural resource base (such as selected Gulf countries) or thanks to a consolidated industry-services system (physical capital, know-how etc) may further develop by attracting labour from excess labour countries and extract labour surplus to further feed their development process.

- ***FDI-based*** development. A further consideration applies to financial sources that may be used to fund capital accumulation to start up and feed development processes. Further to funds from exports, selected countries heavily rely on FDI, above all when they are endowed with natural resources (land, water, minerals, oil) and/or with cheap labour.

- ***Foreign aid-based*** development. Whenever foreign aid is not fully absorbed by immediate emergency-related consumption of subsistence goods (e.g. staple food), selected countries may attempt to kick-start their development process using grants, either channelled to the country through the funding of specific development projects or through the public budget support.

The above-mentioned paradigms are far from being mutually exclusive, as several countries have adopted and are adopting more than one paradigm at the time, as they refer to different phases of economic processes (funding, production, trade), different dimensions of development (economic, social) and impinge on different endowments and resources. For example, a country relying on *Exhaustible-resource export-led* development may have adopted also a *Washington-consensus* set of policies concerning FDI, exchange rate and trade, associated to a strong commitment to promote rural development in selected areas. In addition, the above list does not pretend to be exhaustive as many other factors and related policies might be identified with a closer view of specific country situations and contexts.

Despite these limits, the identified development paradigms are a useful key to interpret the development paths and related policies of single countries or sets of them. More specifically, the development paradigms can be used to explain, e.g. by means of econometric models, the convergence or divergence in the development processes of similar countries adopting different paradigms, of different countries adopting similar paradigms or of similar countries adopting similar paradigms. In addition, as countries are prone to external shocks (e.g. sudden and persistent modifications of their terms of trade), and/or prone to longer term modifications of their development context, (e.g. exhaustion of their resource endowments, incoming environmental constraints due to climate change), the set of development paradigms identified are useful to analyze in such changing contexts, , the development perspectives of selected countries under alternative paradigms, e.g. with country-specific and/or regional computable models. This analysis will enable decision makers to highlight the potential and the drawbacks of alternative development paradigms and provide relevant information to feed decision making processes.

9. Conclusions

After defining the concepts of development and development paradigms, this paper identifies some key "ingredients" of recent past and prevailing development "recipes". Mutual links between these recipes have been explored by browsing selected contributions from the

various strands of literature focusing on development issues. This allowed for the discussion of selected cause-effect relationships which are at the basis of most development processes. This exercise brought the author to identify a set of development paradigms adopted by different countries in different periods and in different development contexts. The author has also highlighted the usefulness of this exercise for further analytical work and for policy decision making in the development domain.

Last but not least, the work has also allowed the author to focus on the prevailing visions of development paths, which to a greater or lesser extent fit into a sort of *Overarching deterministic development path*, according to which countries can be classified as "*developed*", i.e. which have achieved high levels of per capita income, health care services education etc, and as "*developing*". The latter countries are on their way to development, trying to "catch up" with the "developed" ones, following the same paths of the developed countries, in terms of economic growth (from agriculture to industry to services), governance (from autocratic regimes to democracy), socio-economic relationships and consumption patterns (e.g. from local markets to supermarkets, from staple cereals to meat etc).

However, in the light of emerging global development issues, this overarching development path may not be the appropriate key any longer to interpret the present and future evolution of both currently less industrialised and industrialized countries. The overuse of exhaustible energy sources on which almost all industrialization processes have been based so far, the related unsustainable level of carbon emissions leading to climate changes, the recurrent food crises, the general social and political instability of entire regions, widespread across-country and within-country inequalities and persistent poverty and food security, highlight the overall non-sustainability of development of the so called "developed" countries.

Thus it is compulsory to: i) reassess the meaningfulness and usefulness of the dichotomy: "developed" versus "developing" countries; ii) fully revisit the way development has been conceived so far and the ongoing global and national development policies; and iii) design-redesign ongoing/future global, national and local development processes keeping into account the emerging limits mentioned above and the global development needs.

10. References

Acemoglu D., Johnson S., Robinson J.A., (2001): The Colonial Origins of Comparative Development: An Empirical Investigation. The American economic Review. December 2001.

Adelman, I., and Morris, C.T., (1967) Society, Politics and Economic Development. A Quantitative Approach. Hopkins Press.

Aghion P., Armendáriz B. (2004) A New Growth Approach to Poverty Alleviation. MIMEO Harward University.

Aghion, P. Bolton, P. (1997) A Theory of Trickle-down Growth and Development. The review of economic studies, vol. 64, Issue 2 (Apr., 1997), 151-172

Aghion, P. Howitt, P (1990): A Model of Growth Through Creative Destruction. Working Paper No. 3223 January 1990 NBER

Allais M. (1947): Économie et Intérêt. Présentation nouvelle des problèmes fondamentaux relatifs au rôle économique du taux de intérêt et de leur solutions. Paris, Imprimerie nationale. Vol 2(1947),

Anriquez et al. (2003): Anriquez G., Foster, W, Valdéz A. (2003): Agricultural Growth linkages and the Sector's Role as Buffer. Roles of Agriculture Project. FAO. Rome

Anríquez, G., Stamoulis, K. 2007. Rural development and poverty reduction: Is Agriculture Still a Key? e-JADE, FAO- Rome.

Atkinson, A. 1970. "On the Measurement of Inequality." Journal of Economic Theory 2(3): 244–63.

Banerjee A.V., Duflo E (2008): The Experimental Approach to Development Economics Massachusetts Institute of technology, Department of Economics. MIMEO. September 2008. http://econ-www.mit.edu/files/3158.

Barro, R., "Government Spending in a Simple Model of Endogenous Growth," Journal of Political Economy, 98, 1990, S103-S125.

Bellù L.G., Liberati P. (2005): Ranking Income Distributions with Generalised Lorenz Curves. EASYPol series (www.fao.org/easypol) Food and Agriculture Organization of United Nations. Rome.

Bellù L.G., Liberati P. (2005): Impacts of Policies on Poverty: The Definition of Poverty. EASYPol Series (www.fao.org/EASYPol) FAO U.N. Rome.

Bellù L.G. (2008) Windfall Oil Profits and Oil Bills: Some Policy Implications for Sustainable Development. MIMEO.

Berg A., Krueger A., (2003): Trade growth and Poverty: a selective survey, in: Annual conference on development economics: the new development agenda. Edited by Pleskovic B. and Stern N. International Bank for Reconstruction and Development / World Bank. Washington D.C.

Bourguignon, F., Morrisson, C. (1998). Inequality and Development: the Role of Dualism. Journal of Development Economics 57:2, 33-57.

Brealey, R.A., Myers S.C: (1991) Principles of corporate Finance, Fourth Edition (p. 880) Mc Graw Hill.

Brundtland (1987): Our Common Future (1987), World Commission on Environment and Development (WCED) Oxford: Oxford University Press.

Byerlee et al. (2005): Agriculture, Rural Development, and Pro-poor Growth. Country Experiences in the Post-Reform Era. Pp.20-21. Agriculture and Rural Development Discussion Paper 21 The World Bank Washington D.C.

Carvalho, S., White H. (1997): Combining the Quantitative and Qualitative Approach to Poverty Measurement and Analysis. The Practice and the Potential. World Bank technical paper 366.

Cashin P., Mc Dermot C.J, (2006): Properties of international commodity prices: identifying trends, cycles and shocks. In "Agricultural Commodity markets and Trade: Analyzing Market Structure and Instability". Edited by A Sarris and D. Hallam. FAO UN-Edward Elgar 2006.

Chenery , H., M. Ahluwalia (1974): Redistribution with Growth. Oxford: Oxford University Press.

Chow G, C. (1993): Capital Formation and Economic Growth in China. The Quarterly Journal of Economics, Vol. 108, No. 3 (Aug., 1993), pp. 809-842

Cistulli V. (2007): The Global Policy Environment: a Conceptual Framework. EASYPol series n. 99 FAO UN – Rome. www.fao.org/easypol.

Corden, W. M., Neary, J. P. (1982): Booming sector and Dutch disease economics: a survey. Economic Journal, Vol 92.

Collier P., Goderis B. (2009): Commodity Prices, Growth, and the Natural Resource Curse: Reconciling a Conundrum. Department of Economics, University of Oxford.

Collier, P., Hoeffler A.,(2009): Testing the Neocon Agenda: Democracy in Resource-Rich Societies. European Economic Review 53 (2009), 293-308.

Datt G., Ravallion M. (1988): Farm Productivity and Rural Poverty in India, FCND Discussion Paper No. 42 International Food Policy Research Institute. Washington, D.C.

Datt G., M. Ravallion (1992): Growth and Redistribution Component of changes in Poverty Measures: A Decomposition with Applications to Brazil and India in the 1980s. Journal of development Economics 38, pp 275-295.

De Janvry A., Sadoulet E. (2000): Rural Poverty in Latin America: Determinants and Exit Paths, Food Policy, 25, 389-409.

De Janvry, A. Sadoulet, E. (1998): Growth, Poverty, and Inequality in Latin America: a causal analysis, 1970-1994. Department of Agricultural and Resource Economics Working Paper no.784. Berkeley, University of California USA.

Dixit, A., (1970): Growth patterns in a dual economy. Oxford Economic Papers, 22 (2) July 1970, pp. 229-33.

Dollar, D., Kraay, A. (2004), Trade, Growth, and Poverty. The Economic Journal, 114: F22–F49.

Easterly W. (2006): The white man's burden: why the West's approach to aid the rest has done so much hill and so little good. Penguin Press, New York.

Easterly W., (2006): Reliving the 50s: the Big P, Poverty Traps, and Takeoffs in Economic Development. MIMEO. http://williameasterly.files.wordpress.com

Easterly W. (2009): How millennium development goals are unfair to Africa. World development, Vol. 37, No. 1, pp. 26–35, 2009.

Easterly W., Pfutze T. (2008): Where Does the Money Go? Best and Worst Practices in Foreign Aid. Journal of Economic Perspectives—Volume 22, Number 2—Spring 2008.

European Commission (2008): The Concept of Clusters and Cluster Policies and their Role for Competitiveness and Innovation: Main Statistical Results and Lessons Learned.

Commission Staff Working Document SEC (2008) Europe INNOVA / PRO INNO Europe paper N° 9.

FAO (2003): Anti-Hunger Programme: A twin-track approach to hunger reduction: priorities for national and international action Food and Agriculture Organization of the United Nations. Rome.

FAO (2005): An approach to rural development: Participatory and Negotiated Territorial Ddevelopment (PNTD). Rural Development Division Food and Agriculture Organization of the United Nations (FAO) April 2005. http://www.fao.org/sd/dim_pe2/docs/pe2_050402d1_en.pdf

FAO (2008): Initiative for Soaring Food Prices: programme document, May 2008 FAO UN – Rome. (http://www.fao.org/isfp/isfp-home/en/)

FAO (2009): From Land Grab to Win-Win. Economic and social perspectives. Policy brief 4, June 2009 FAO – Rome.

FAO (2009): State Of Food and Insecurity (SOFI) 2009. FAO Rome.

Fei, J. C. H., Ranis, G. (1964): Development of the Labour Surplus Economy, Homewood: Irwin, 1964

G8 (2009): L'Aquila Joint Declarations: Promoting the Global Agenda (2009) http://www.g8italia2009.it/static/G8_Allegato/G8_G5_Joint_Declaration.pdf and: L'Aquila Joint Statement on Global Food Security http://www.g8italia2009.it/static/G8_Allegato/LAquila_Joint_Statement_on_Global_Food_Security[1],0.pdf

Galor, O., Zeira J. (1993): Income Distribution and Macroeconomics. Review of Economic Studies (1993) 60 (1): 35-52

Galor, O., Moav O. (2004): From Physical to Human Capital Accumulation: Inequality and the Process of Development. Review of Economic Studies, Vol.71, 4, pp 1001-1026, Dec 2004.

Gilbert C. L. (2006): Trends and volatility in Agricultural Commodity Prices. In "Agricultural Commodity markets and Trade: Analyzing Market Structure and Instability". Edited by A Sarris and D. Hallam. FAO UN-Edward Elgar 2006.

Gore (2000): The rise and fall of the Washington Consensus as a Paradigm for Developing Countries. World Development Vol 28 No 5 pp 789-804, 2000

Grilli E.R., Yang M.C. (1988): Primary commodity prices, manufactured goods prices and the terms of trade of developing countries: what the long run shows. World Bank Economic Review , 2, 1-47.

Grossman, G., Helpman E. (1989): Product Development and International Trade. Journal of Political Economy, December 1989, 97:6, 1261-83

Harris, J. R., and Todaro, (1970): M . P., Migration, Unemployment and Development: a two-sector analysis. The American Economic Review, 60 (1) , Mar. 1970, pp. 126-42.

Harrod R. F (1939): An Essay in Dynamic Theory. The Economic Journal, Vol. 49, No. 193. (Mar., 1939), pp. 14-33. and: Domar, E. (1946), 'Capital Expansion, Rate of Growth and Employment', Econometrica.

Hazell, P. (1999): Agricultural Growth, Poverty Alleviation, and Environmental Sustainability: Having it All, IFPRI, Washington D.C.

Hazell, P. and Haggeblade, S.(1993): Farm/non-farm growth linkages and the welfare of the poor. In: Lipton, M. and van de Gaag, J. (Eds.), Including the poor. The World Bank, Washington, D.C.

Hirschman, A., O. (1958): The strategy of Economic Development, Yale University Press, New Haven, Connecticut.

Johnston B.F, Mellor J,W. (1961): The role of agriculture in economic development, American Economic Review 51(4): 566-593, 1961.

Jorgenson D., W. (1967) Surplus Agricultural Labour and the Development of a Dual Economy, Oxford Economic Papers.1967; 19: 288-312

Josling T. (1998): Agricultural trade policy: completing the reform. Policy analyses in international economics, 53. Institute for International Economics. Washington D.C.

Kawani N., (1993): Poverty and Economic Growth with Application to Cote d'Ivoire. Review of Income and Wealth 39, 121-139.

Kakwani N., Pernia E.M., (2000): What is pro-poor growth? Asian Development Review, vol. 18, no. 1, Asian Development Bank

Kakwani N., Son, H. (2003): Pro-poor Growth: Concepts and Measurement with Country Case Studies. The Pakistan Development Review 42 : 4 Part I (Winter 2003) pp. 417–444

Khan, H.A. (1999): Sectoral growth and poverty alleviation: a multiplier decomposition technique applied to South Africa. World Development.

Kidane,W, Maetz, M. (2006): Food Security and Agricultural Development in Sub-Saharan Africa: Building a Case for More Public Support. FAO UN policy Assistance Series;

Kose, M., Riezman, R., (2001): Trade shocks and macroeconomic fluctuations in Africa. Journal of Development Economics 65, 55–80.

Kraay, A. (2004): When is Growth Pro-Poor? Evidence from a Panel of Countries. The World Bank, Policy Research Working Paper No. 3225.

Krueger, A. (1998): Why Trade Liberalisation is Good for Growth. The Economic Journal, 108: 1513–1522.

Kutznets, S. (1964): Economic Growth and the Contribution of Agriculture: Notes for measurement" In C. Eicher and L. Witts: Agriculture in Economic Development. New York. McGraw-Hill.

Kuznets S. (1955): Economic Growth and Income Inequality. The American Economic Review, Vol. 45, No. 1. (Mar., 1955), pp. 1-28.

Lewis, W. A. (1954): Economic Development with Unlimited Supplies of Labour. The Manchester School, Vol. 22, pp. 139–191.

Lucas, R. E., Jr., (1988): On the Mechanics of Economic Development. Journal of Monetary Economics, July 1988, 22:1, 3-42.

Mankiw, N. G., Romer D., and Weil D. N.(1992): A Contribution to the Empirics of Economic Growth. Quarterly Journal of Economics, May 1992, 107, 407-37.

Morris, C. T., Adelman I. (1988) Comparative Patterns of Economic Development, 1850-1914. Hopkins Press

Morrison C., E., Thorbecke (1990): The concept of Agricultural Surplus. World Development 18 (8) 1081-1095

Mundlak, Y. (2000): Agriculture and Economic Growth Theory and Measurement. Harvard University Press

OECD (2002): Foreign Direct Investment for Development: Maximizing Benefits, Minimizing Costs. Paris, 2002

O' Ryan, R. Miller, S., (2003): The Role of Agriculture in Poverty Alleviation, Income Distribution and Economic Development: A CGE Analysis for Chile. Roles of Agriculture (ROA) project FAO-UN Rome.

Oxford English Dictionary. http://oxforddictionaries.com

Pingali P. (2006): Agricultural Growth and Economic Development: a view through the globalization lens. FAO- Rome

Prebisch R (1950): The Economic Development of Latin America and its Principal Problems. United Nations Dept. of Economic Affairs, 1950.

Pyatt, G. Round, J. I. (1979): Accounting and fixed price multipliers in a SAM framework. Economic Journal, 89 (356): 850-873.

Raddaz C. (2007): Are external shocks responsible for the instability of output in low-income countries? Journal of Development Economics 84 (2007) 155–187.

Ramsey F, P.(1928). A mathematical theory of saving. Economic Journal, vol. 38, no. 152, December 1928, pages 543–559.

Ravallion, M. (2004) Pro-poor Growth: A primer. Washington ,D.C.: Development Research Group, The World Bank.

Ravallion, M., Chen S. (1997): What Can New Survey Data Tell us about Recent Changes in Distribution of Poverty? The World Bank Economic Review 11: 357-382.

Ravallion, M., Chen S. (2003): Measuring Pro-Poor Growth. Economics Letters 78 (2003) 93–99.

Ricardo D. (1817): On the Principles of Political Economy and Taxation. http://www.econlib.org/library/Ricardo/ricP.html

Rodriguez F., Rodrik D. (2001): Trade Policy and Economic Growth: A Skeptic's Guide to the Cross-National Evidence . NBER Macroeconomics Annual 2000, Volume 15.

Rodrik, D. (1999): Where Did All the Growth Go? External Shocks, Social Conflict, and Growth Collapses Journal of Economic Growth Volume 4, Number 4 / December, 1999.

Romer P., M. (1986): Increasing Returns and Long-Run Growth. The Journal of Political Economy, Vol. 94, No. 5 (Oct., 1986), pp. 1002-1037.

Romer, P. M. (1994): The Origins of Endogenous Growth. The Journal of Economic Perspectives, Vol. 8, No. 1. (Winter, 1994), pp. 3-22.

Rostow W.W. (1960): The Stages of Economic Growth. A non-communist Manifesto. First Edition. Cambridge University Press.

Sadoulet E., Subramanian S. and De Janvry A. (1992) : Adjusting to a Food Price increase in the context of Stabilization Policies : An Analysis Using Archetype Financial CGE for Developing Countries. Report prepared for the World Bank.

Sachs, J. D., Warner, A. M (2001): The curse of natural resources, European Economic Review, Volume 45, Issues 4-6, May 2001, Pages 827-838.

Sen A. (1999): Development as Freedom. Alfred A. Knopf, New York, 1999.

Shumpeter J. (1911): The Theory of Economic Development: An inquiry into profits, capital, credit, interest and the business cycle (original title in German) 1911.

Singer (1998): The terms of trade fifty years late: convergence and divergence South Letter No. 30, Volume 1, 1998 The south centre http://www.southcentre.org

Singer, H. W. (1950): The distribution of gains between investing and borrowing countries. American Economic Review, Papers and Proceedings 40 (2 (May), 473-485

Solow R.M (1956): A contribution to the theory of economic growth. The quarterly Journal of Economics Vol 70, No. 1 (Feb.1956). 65-94

Son H., (2004): A Note on Pro-Poor Growth. Economics Letters 82 (2004) 307–314

Son H., H , Kakwani N. (2008): Global Estimates of Pro-Poor Growth. World Development Vol. 36, No. 6, pp. 1048–1066, 2008.

Stiglitz, J. (1998) Towards a New Paradigm for Development: Strategies, Policies, and Processes. Prebisch lecture at UNCTAD, Geneva October 19, 1998.

Stiglitz J. (2006): Social justice and global trade. Social Europe the journal of the European left. Autumn 2006.

Taylor L, Arnim von R. (2006): Modeling the impact of trade liberalization. A critique of computable general equilibrium models. Oxfam research report July 2006.

The Economist (1977): The Dutch Disease. November 26, 1977. pp. 82-83.

Thirtle C., Lin L., Piesse, J. (2003): The Impact of Research-Led Agricultural Productivity Growth on Poverty Reduction in Africa, Asia and Latin America. World Development, Elsevier, vol. 31(12), pages 1959-1975, December.

Tiffin R, Irz X, (2006): Is agriculture the engine of growth? Agricultural Economics, 35: 79–89. July 2006.

Timmer, C.P. (1997): How well do the poor connect to the growth process? Cambridge, Mass., USA, Harvard Institute for International Development

Timmer, C.P., (2002): Agriculture and economic development. In: Gardner, B. and Rausser, G.(Eds.), Handbook of Agricultural Economics. Elsevier Science, Amsterdam, North Holland.

Timmer, C.P., (2003): Agriculture and Pro-Poor Growth. The Pro-Poor Economic Growth Research Studies. Boston Institute for Developing Economies.

Timpano, F. Piva M. (Editors) (2008): Cluster Policies and Local Development. Vita e Pensiero ed. Milano.

Todaro, M, Smith, S. (2003): Economic Development, Essex, Pearson Education Limited.

UNDP (2010) Human development Report 2010. The real wealth of nations: pathways to human development. http://hdr.undp.org/en/media/HDR_2010_EN_Complete_reprint.pdf

United Nations (2000): United Nations Millennium Declaration. Resolution adopted by the General Assembly. 8th plenary meeting, 8 September 2000. http://www.un.org/millennium/declaration/ares552e.htm

Williamson, J. (1990): What Washington Means by Policy Reform. In J. Williamson, ed., Latin American Adjustment: How Much Has Happened? (Washington: Institute for International Economics).

Winters, P., De Janvry A., Sadoulet E., Stamoulis K, (1996): The role Of agriculture in economic development: visible and invisible surplus transfers. Department of resource economics, working paper n 143.

World Bank (1990): World Development Report 1990: The International Bank for Reconstruction and Development/The World Bank. Washington, D.C.

World Bank (2004): Global monitoring report. Policies and actions for achieving the Millennium Development Goals and related outcomes. The International Bank for Reconstruction and Development/The World Bank. Washington, D.C.

World Bank (2005): Agricultural growth for the poor: an agenda for development. The International Bank for Reconstruction and Development/The World Bank. Washington, D.C.

World Bank (2008): World development report 2008: Agriculture for development. International Bank for Reconstruction and Development/ The world Bank. Whashington D.C.

International price shocks and development: A general equilibrium approach with applications to Burkina Faso.

Part 2:

Analyzing policy impacts and international price shocks: Alternative Computable General Equilibrium (CGE) models for an aid-dependent less-industrialized country

Tesi di Dottorato di Lorenzo Giovanni Bellù
Matricola: 3580130
Anno accademico 2009-2010

Abstract
This paper addresses the issue of analyzing how complex socio-economic systems are hit by and adjust to external shocks and polices. In the first section the focus is put on the structure of a socio-economic system, and on "entry points" of different types of shocks and policies. Subsequently, alternative general equilibrium models are analyzed, with a focus on macro-economic and factor markets closures, highlighting how different closures imply different assumptions related to the way the economic system and related adjustments work. To test how different ways of designing general equilibrium models may influence actual decision making in less industrialized economies, a one-sector, two-household, two-factor general equilibrium model is designed and calibrated on an "archetypical" Social Accounting Matrix of a less industrialized, aid-dependent country. Alternative macro-economic and factor market closures are tested focusing on the mechanisms through which the economic system adjusts to external shocks such as import price upward shifts. Conclusions highlight that: 1) different ways of modelling the economic systems lead to significantly different impacts of the same simulated external shock on import prices; 2) the results are particularly sensitive to the level of the elasticities of substitution of domestic goods with domestic ones; and 3) in aid-dependent economies, characterized by an high foreign dependency ratio of the government budget and an high level of foreign borrowing due to the external trade deficit, trade shocks affecting the real exchange rate largely affect the system and the welfare of households. This due to the fact that they affect the real exchange rate, which in turn shift the value of both foreign savings in domestic currency in the Savings-Investment balance and the foreign transfers in domestic currency in the government balance. These shifts require the adjustments of the S-I and government balances through the adjustments of all the other endogenous variables entering these balances. This particularly applies when investment demand and government consumption are exogenous and kept fixed to the pre-shock level.

Table of contents

1 Introduction....5
2 Analyzing economic systems and their adjustments to policies and shocks....5
2.1 Structure of a socio-economic system....6
2.2 Identifying entry points of policies and shocks into an economic system....7
2.3 Modelling impacts of policy measures and shocks....10
3 Alternative computable general equilibrium models (CGE)....11
4 Applying general equilibrium models for actual decision making....23
4.1 A one-sector, two-household, two-factor general equilibrium model....24
4.2 An "archetypical" SAM of an aid-dependent less industrialized country....29
4.3 Alternative macro-economic and factor market closures....31
5 Some policy implications....40
6 Conclusions....41
7 References....43

1. Introduction

This paper proposes an analysis of the way different external shocks or policy measures affect an economic system, with the aim of identifying analytical implications relevant for policy making. Even economic policies, aimed at affecting specific segments of the economic system may have significant spill-overs and macro-economic impacts through the channels mutually linking production activities, factor markets, households, the government and the "rest of the world". For this reason CGE models are widespread tools to simulate ex-ante the possible impacts of various policy options. However, the results of the simulations have to be interpreted in the light of the macro-economic and factor-related assumptions undertaken. Various authors carried out comparative analyses of alternative macro and factor market closures, such as Sen (1963), Pasinetti (1972), Taylor –Lysy (1978), Rattso (1982), De Melo, Robinson (1989). However, the results of the alternative closure rules and the extent of their mutual discrepancies depend also on the structure of the economic system under investigation. For socio-economic development policy making it is important to better understand the extent to which the different closures affect the results of CGE models when they are applied to less industrialized countries with specific features. After section 2, illustrating how policies and external shocks affect a complex socio-economic system, detailed discussion of selected alternative macro-economic and factor market closure is carried out in section 3. To investigate the extent to which the different macro and factor market closures provide different results, a simple one-sector, two-factor, two-household general equilibrium model is designed and presented in section 4.1. The SAM of a "paradigmatic" aid-dependent oil-importing less-industrialized country adopted to calibrate the CGE model is presented in section 4.2. Some tests with alternative closure rules carried out simulating the impacts of an international import price shock are presented and discussed in section 4.3. Some implications for policy making emerging from the different ways of modelling socio-economic systems are presented, together with concluding remarks at the end of the paper.

2. Analyzing economic systems and their adjustments to policies and shocks

Identifying and describing the fundamental relationships among the constituting elements of an economic system is a pre-requisite for understanding how this system evolves and adjusts to stimuli coming from external shocks or policy measures. Any kind of economic analysis, to generate new knowledge and to be functional to decision making processes, should consider the causal links between a shock, whether policy-induced or generated by other external factors, and the modifications likely to occur in the economic system.

External shocks and policy measures affect a socio-economic system by modifying the behaviour of economic agents, whether they are producers, consumers or suppliers of factor services, such as workers, investors or renters. To understand how external shocks and policy measures modify the behaviour and relations among different economic agents within an economic system and to obtain analytical results relevant for decision making in policy processes, it is worth: 1) exploring the structure of a

socio-economic system; 2) identifying "entry points" of the different policy measures and other shocks into the economic system; and 3) modelling the economic system and the causal relationships linking policies-shock to impacts.

2.1. Structure of a socio-economic system.

A socio-economic system can be seen as a set of elements, mutually linked by means of physical flows (flows of goods and services) and countervailing flows of payments, flowing in the opposite direction. The System of National Accounts of the United Nations (SNA UN)[117], a standard approach for national accounts adopted by almost all countries, identifies some basic elements of a socio-economic system. For each of these, inflows and outflows of payments (income and expenditure, respectively) are recorded on two-side balancing accounts for each period (usually a year). These elements comprise:

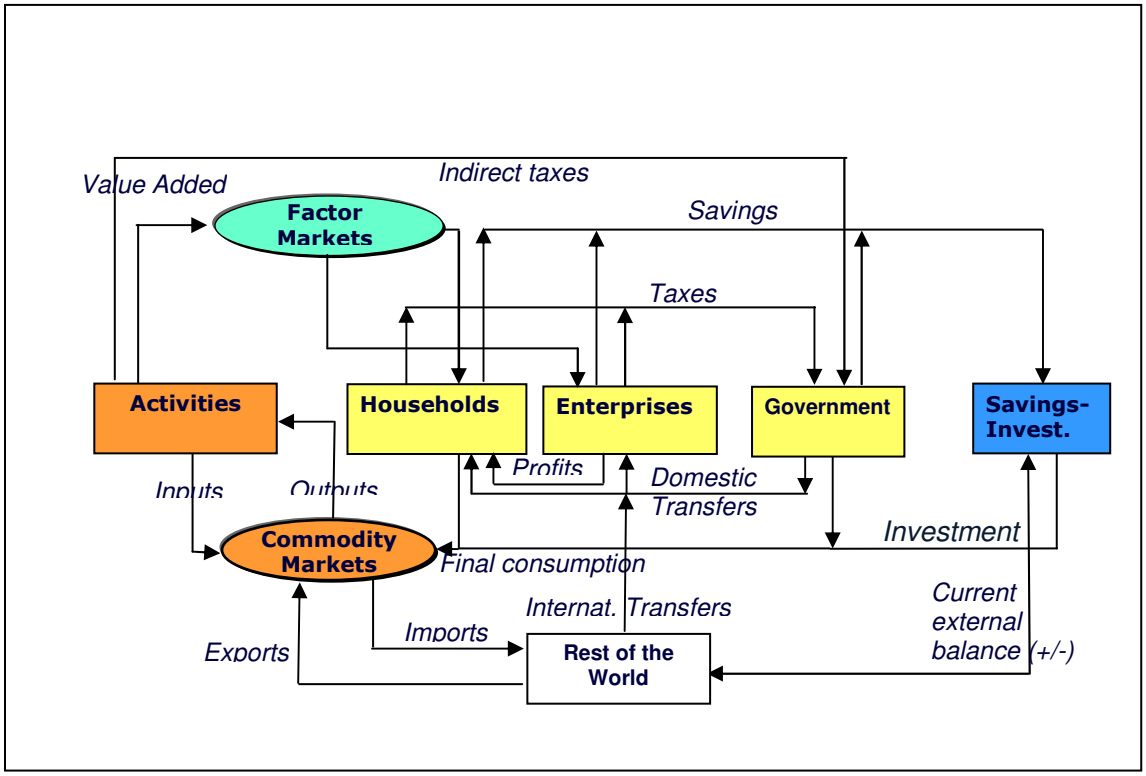
1. **Commodities:** Goods and services produced, purchased, sold and consumed by various economic agents within an economic system. Commodities are exchanges on commodity markets where supply and demand meets;
2. **Activities:** Economic sectors (industries) which produce commodities by using other commodities (intermediate consumption), factor services;
3. **Factors:** Services provided by economic agents for activities such as labour, land and capital services; remunerated by payments such as wages, rents, interests, profits.
4. **Institutions**: Economic agents such as households, enterprises and the government. They are classified as "private" institutions (households, enterprises) and "public" (the government). Private institutions provide factor services to activities, and to other institutions, by supplying them on factor markets. Private institutions are remunerated with payments for factor services, which constitute their income. Institutions consume final consumption goods and services, whose payments constitute their expenditure. The part of income not spent is saved. The government, as a public institution, collects taxes from other institutions (direct taxes) and activities (indirect taxes). It transfers money to other institutions and activities (public transfers) and directly provides selected services (defence, justice etc.).
5. **Savings-Investment**. This account keeps track of the savings (income not spent) of the institutions and of the demand for investment goods. This account acts as a peculiar "institution" which receives the income not spent from the other institutions (their savings) and allocates it to purchase investment goods. In addition, this account may receive savings from the Rest of the World (RoW) or may "invest" lending money to the RoW.
6. **"Rest of the World" (RoW).** This is an account that keeps track of the transactions between the domestic agents and the economic agents outside the economic system, i.e. the rest of the world. The inflows of this account comprise payments for imports; payments for services provided by foreign agents to the national economy; such as immigrants into the country, expatriation of earnings of foreign corporations and transfers from domestic institutions to foreign

[117] United Nations, Statistical Division (1993): System of National Accounts. http://unstats.un.org/unsd/sna1993/toctop.asp

institutions. The outflows comprise payments for exports, remittances of emigrants and transfers from foreign to domestic institutions[118].

These elements and the flows of income interlinking them are represented in Figure 1.

Figure 1: Elements of a socio-economic system and their mutual linkages



Source: Freely adapted from Round (2003)

2.2. Identifying entry points of policies and shocks into an economic system.

Development policies affect an economic system through the use of policy instruments, i.e. variables or sets of variables directly under control of decision makers. Also non policy-led external shocks, such as shifts of exogenous international prices or exogenous technological changes, enter the economic system through the direct modification of selected variables affecting the behaviour of economic agents. Different policy measures mostly adopted to stimulate development or react to

[118] In the SNA, the RoW and S-I accounts are used to square up the two-side, balanced accounts system. The balance of the RoW account in a given period represents the deficit or surplus of the RoW towards the country in that period. If it shows a deficit, this implies a surplus in the current external balance of the country, i.e. the RoW received more money from the country than it paid. The balance is then transferred to the Savings-Investment account as an "investment of the country" abroad. In this case, the country is a net lender to the RoW. If the RoW account shows a surplus, this implies that the RoW received less money from the country than it paid out. The balance is then transferred to the Savings-Investment account as a "foreign savings". In this case, the country is a net borrower from the RoW. Note that being this a two-side, balanced accounting system, once all the other accounts balance, the deficit-surplus of the RoW account exactly matches the surplus-deficit of the S-I account.

external shocks such as a) price policies; b) macro-economic policies; c) public investment policies, are normally implemented through the use of different policy instruments, i.e. socio-economic variables directly or indirectly under the control of the policy makers.

Price policies, i.e. policies aimed at directly shifting the relative prices of one good or a set of goods with respect to the others are generally implemented through:

1. ***Domestic Indirect Taxes and subsidies.*** They directly affect relative domestic prices. Instruments used comprise diversified Value Added Tax (VAT) rates, exemptions and deductibility, taxes or subsidies on specific activities or commodities (excises).
2. ***International trade Taxes, tariffs and quantitative-qualitative restrictions*.** They influence prices and quantities of competing products imported into or exported from the country. Instruments used comprise diversified tariffs or quotas on imports and subsidies on exports.
3. **Direct controls and interventions.** They consist of direct government regulations of prices, marketing margins or production choices and can create excess supply or demand at administered prices to benefit either consumers or producers**.** Examples comprise policy measures such as controls on basic foods such as cereals, dairy products etc, and purchase of selected harvests at above the market prices.

Macroeconomic policies are economy-wide interventions affecting macro-economic aggregates and balances and potentially affecting all agents and commodities. They comprise:

1. ***Monetary and credit policies*,** affecting the overall supply of money, the level of domestic prices and related inflation, the interest rate and the availability of credit in the economic system, and through them, the level and composition of the production in the short run.
2. ***General fiscal policies,*** affecting the overall level of government deficit/surplus, as it results from the application of specific sectoral or commodity incentive-disincentive fiscal measures but also by setting the general level of income taxes. Fiscal policies directly affect: households through taxes on income and deductible value added taxes; activities, through taxes on production and factor use; and enterprises, through taxes on profits.
3. ***Foreign exchange rate policies***, i.e. policies affecting the domestic price of one unit of foreign currency, affecting in turn the relative prices of foreign versus domestic commodities.
4. ***Factor and resource management policies,*** which directly affect the remuneration of factors (land, labour, capital etc) Examples: minimum wage policies; support to negotiations between employers and workers, policies affecting land rental rates and/or land availability such as subsidised sales of state-owned land, issue of licenses for natural resource use, etc.

Public investment policies, which affect the existing capital stock. They can affect various groups of agents – producers, traders, and consumers – differently, as they may be specific to the areas where the investment occurs and/or to segments of specific value chains. However, if their volume is important, they may affect the whole economic system via cross-sectoral linkages, factor use and other spillovers. These comprise:

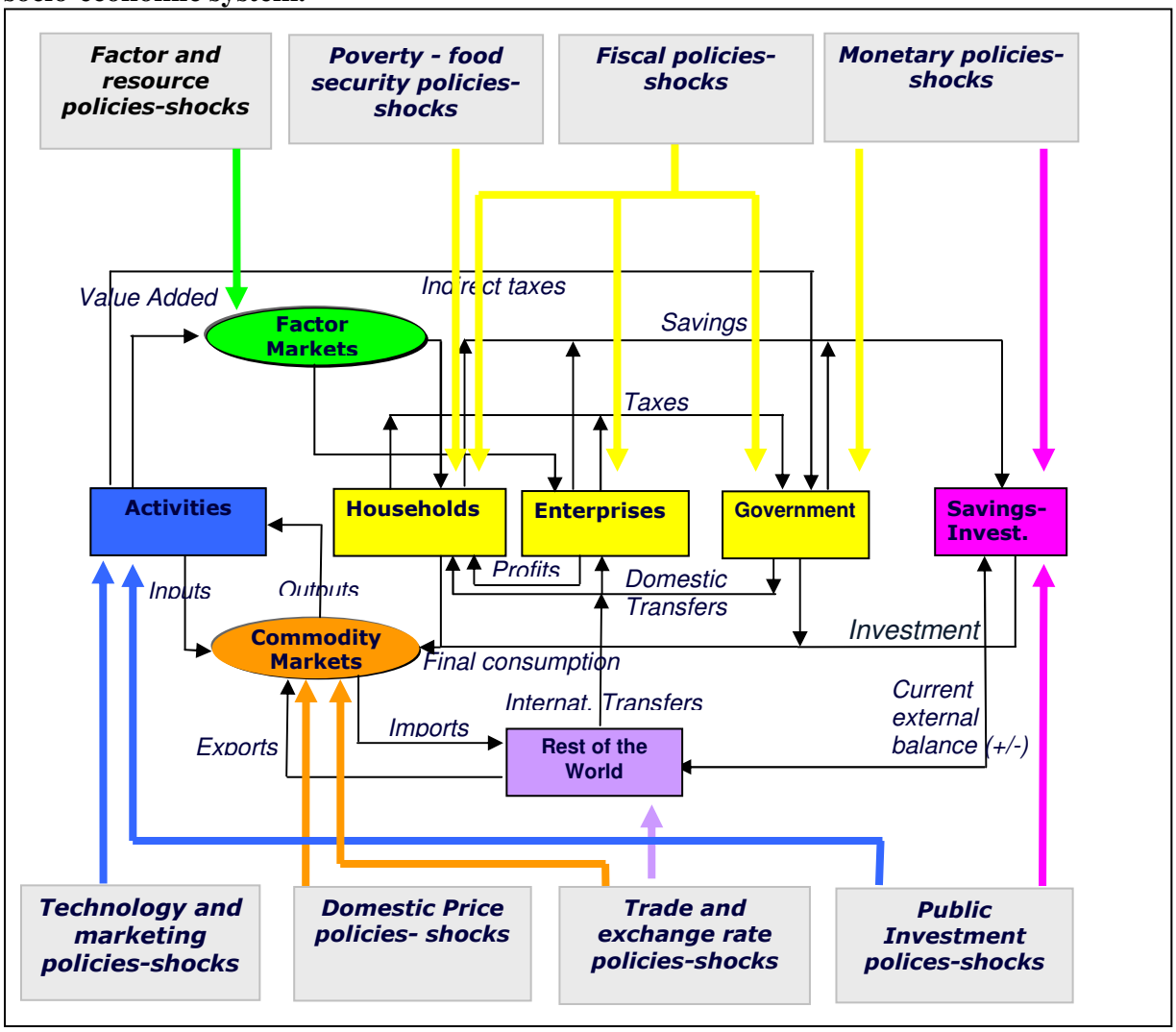
1. ***Public investment in infrastructure*.** This includes the construction of essential capital assets such as roads, ports, and irrigation networks; provision of transport facilities; collection centres and storage deposits, communication and energy networks, etc. These interventions are likely to raise returns to producers or lower their production costs, with possible advantages also to consumers**.**
2. ***Public investment in human capital*.** This consists of government expenditure to improve knowledge and skills of producers and consumers**.** Examples comprise: investments in schools, training and extension centres but also improved health care facilities to ease participation to education and production processes.
3. ***Public investment in research and technology*.** This is related to research in new production technologies, aiming at improving productivity and sustainability and identifying new products. Examples include better water control; energy-saving and carbon-reducing production processes, development of drugs, development and provision of technological breakthroughs, etc.

In addition to the above types of policies, a specific set of policies refers to **direct poverty alleviation and food security**. This aims to directly and immediately provide food (or entitlements to food) and/or increase the well-being of the most in-need people.

The range of policy measures listed above, as well as non-policy induced exogenous shocks affecting the same variables, have direct and immediate impacts on different parts of a socio-economic system. For example, trade and exchange rate policies directly affect imports and exports of goods and services by shifting domestic prices in relation to international ones. Investment and natural resource management policies may have direct impacts on production processes due to their capacities to shift the relative costs and productivity of various inputs and factors. The same may apply to specific technology and marketing policies; the latter particularly affecting the downstream segments of value chains. Factor policies may affect both agricultural and industrial sectors as well as the purchasing power of factor owners. In addition, as mentioned above, some policy measures, such as poverty alleviation or emergency policies may directly affect poverty and/or food security in both rural and urban areas. Figure 2 summarises the ways in which different policies directly affect specific parts of a socio-economic system.

In addition to the type of policies described above and visualized in figure 2, "institutional policies", i.e. policies explicitly aimed at building and supporting institutions play a crucial role in the development of socio-economic systems. Among these polices, we can mention all the interventions aimed at ensuring the proper working of markets, including policies aimed at addressing negotiating power asymmetries between counterparts in labour markets, policies and regulations ensuring the sustainable use of the natural resource base, policies which reinforce institutions deputed to the enforcement of laws and regulations, consensus building, empowerment, conflict solving etc. Even if the changes in the quantity and quality of services generated by the implementation of these policies are difficult to assess in quantitative terms, they largely contribute to improve the overall functioning of the socio-economic system by, for instance, smoothing the relationships among social groups, reducing transaction costs among economic counterparts, positively shaping the relationships among citizens and public powers.

Figure 2: Different types of policies-shocks and their entry points in the socio-economic system.



However, in addition to direct affects, the circular flow of payments linking the different elements of a system, gives rise to cross-sectoral and inter-institutional effects, i.e. to the activation of other parts of the economic system due to changes in one part. For example, increased household incomes may activate the demand of industrial goods, which in turn may activate the demand of industrial inputs and factors. This generates employment, increases the household income and further increases the demand of goods, thus increasing again incomes. In addition, investment may accelerate these effects by enhancing, period after period, the stock of capital and the efficiency of production and distribution processes.

2.3. Modelling impacts of policy measures and shocks

Mathematical models can be used to quantify policy and shock impacts as long as they embody the essential features of economic systems and allow tracing the causal relationships linking exogenous changes to relevant socio-economic variables. This

holds also for general equilibrium models, which are systems of simultaneous equations describing the essential elements of an economic system and related mutual linkages. Policy and shock impacts result by a counterfactual analysis, i.e. the comparison of the solutions of the model with and without the policy or shock[119]. Values of relevant endogenous variables, i.e. variables whose values are determined by the solution of the equations, calculated "at the benchmark", i.e. in a situation of reference, are compared with those calculated when relevant policy or other exogenous shocks are introduced by modifying selected exogenous variables (parameters). The difference or the percentage change of the endogenous variables or related indicators provides information on the impacts of the shocks on the economic system.

However, results of impact analyses depend, in addition to the type and magnitude of the exogenous shocks introduced into the model, by the way the economic system is modelled. More specifically, results are particularly sensitive to the assumptions regarding the so-called macro-economic and factor-markets closures, i.e. the way the equilibria of macro-economic balances such as the government budget, the saving-investment account and the current external current account, as well as the equilibria of the factor markets are achieved after the shock. Indeed, different assumptions regarding the above-mentioned balances reflect completely different visions on how the economic system adjusts to external shocks. In the following sections this issue will be addressed by exploring selected alternative approaches for modelling macro-economic balances and the equilibrium of factor markets in a general equilibrium context. Applications to an "archetypical" less industrialized country will allow us to illustrate the extent to which different modelling choices affect model results and, by way of consequence, policy decisions.

3. Alternative computable general equilibrium models (CGE)

The concept of general equilibrium of an economic system dates back to Walras (1874)[120], who highlighted how given a set of interrelated markets where supply and demand of different commodities meet under free competition, it is possible to determine a set of prices which implies the equilibrium of all the markets, and where each price matches the cost of production of each commodity. In more recent times Arrow and Debreu (1954)[121], Debreu (1959)[122] and others formalized this concept to allow its application to real economies. Selected authors, pioneered the application of general equilibrium models to actual economic issues such as Chenery and Uzawa (1958) to economic development, Johansen (1960) to economic growth, Harberger (1962) to corporate income taxes[123]. Showen and Walley (1972, 1974) extended the

[119] On the use of counterfactual analysis in policy decision making see e.g. Bellù L.G., Pansini R.V. (2009): Quantitative Socio-Economic Policy Impact Analysis: A Methodological Introduction. EASYPol series n.235. www.fao.org/easypol Food and Agriculture Organization of U.N -Rome.

[120] Walras, L. (1874) Éléments d'économie politique pure, ou théorie de la richesse sociale (Elements of pure economics, or theory of social wealth.) Lausanne, L. Borbax ed.

[121] Arrow, K and Debreu, G. (1954). *Existence of a Competitive Equilibrium for a Competitive Economy*. Econometrica **22** (3): 265-290

[122] Debreu, G. (1959) Theory of value: an axiomatic analysis of economic equilibrium. New York, Wiley

[123] Chenery, H.B. and Uzawa H. (1958) Non-linear Programming in Economic development. In Arrow,K. Hurwicz, L. an Uzawa H. (eds) Studies in linear and on-linear programming, Palo Alto CA. Stanord University press.

use of general equilibrium models to capital income and commodity taxes[124]. Application to real cases has also been permitted by the works of various mathematical economists, such as Scarf, (1960, 1967), Merrill (1972), Van de Laan and Talman (1979), who worked out methods to actually compute vectors of equilibrium prices. A comparative review with illustrations of these methods can be found in Showen and Walley (1992)[125].

Since then, countless applications of general equilibrium models have been carried out to simulate ex ante the impacts of different policies and different types of models emerged according to various criteria such as: the specific purposes of the analysis, the different theoretical underpinnings specifically related to the causality links assumed to prevail in the economic system, their level of aggregation, the sources of statistical data utilized, the importance assigned to spatial factors, the time span covered etc. However, despite these multiple differences, following Willenbockel (1994)[126] two major families of CGEs can be identified, according to their conceptual and operational roots: 1) CGEs rooted on the tradition of applied neoclassical welfare analysis; and 2) CGE rooted in the tradition quantitative development planning. Within the first category fit all the models adhering to the so called "Neo-Walrasian" paradigm. This category is traced back to the mentioned work of Harberger (1962) and includes the work of various authors such as Scarf, Showen and Whalley. Studies in this tradition assume that all the agents supplying and/or demanding factors and goods perform according to an optimizing behaviour, there is homogeneity of degree zero in prices and incomes, and there exist an appropriate set of prices for goods and factors which clear all the markets. The typical use of models following this approach is to carry out ex-ante comparative static analysis of policy impacts. Appropriate sets of clearing prices are identified at the benchmark (i.e. in the scenario without any policy change) and under the various scenarios reflecting the simulated policy changes. In the second category, named "Less-orthodox CGEs" Willenbockel fits the works which to a lesser or greater extent relax the strict Walrasian framework by introducing non-Walrasian elements such as nominal price rigidities, unbalanced government budgets in equilibrium, nominal exchange rates etc. This category hosts the pioneer contributions of Johansen (1960), a large number of CGE models designed for less-industrialized countries, but also large-scale multipurpose models such as the ORANI model of Australia by Dixon et al (1982), the Michigan model of

---

Harberger, A, (1962) The incidence of corporate income tax. Journal of political economy. 70: 215-240

[124] Showen, J.B. and Whalley J. (1972) A general equilibrium calculation of the effects of differential taxation on income from capital . Journal of public economics 1, 281-322.

Showen, J.B. and Whalley J. (1974) A proof of the existence o a general equilibrium with ad valorem commodity taxes. Journal of economic theory 8, 1-25.

[125] Scarf, H.E. (1960). Some examples of global instability of the competitive equilibrium. International economic review, 1, 157-172.

Scarf, H.E. (1967). The approximation of fixed points of a continuous mapping. SIAM. Journal of applied mathematics. 15, 1328-43.

Merril, O.H. (1972). Applications and extension of an algorithm that computes fixed points of certain uppersemi-continuous point to set mapping. Department of Industrial Engineering, University of Michigan.

Van der Laan, and G., Talman, A. J (1979). A restart algorithm for computing fixed point without an extra-dimension. Mathematical programming 17, 74-84.

Showen, B.J., Walley, J. (1992) Applying general equilibrium. Cambridge surveys of economic literature, Cambridge University Press.

[126] Willenbockel D. (1994) Applied general equilibrium modelling: Imperfect competition and European integration. Wiley.

world trade by Deardoff and Stern (1986)[127]. In addition, this category hosts the contributions of the so called "macro-structuralists", such as Lance Taylor (1990), who see themselves more in the tradition of Keynes, Kalecki and Kaldor rather than Walras, arrow and Debreu, and emphasize how the causation links in a CGE run from the macro-economic equilibrating mechanisms to the micro-economic distributional implications, i.e. the macro-closures chosen substantially influence the outcomes of the models.

Missaglia (2011)[128] provides important hints to interpret the various strands of theoretical and applied CGE literature. Even if he does not provide a systematic clustering of the contributions in this domain, discusses in a formalized comparative way the salient features of: 1) Neo-classical models; 2) "Bastard Keynesian" models; and 3) Structuralist, post-Keynesian models; and 4) Stock-flow consistent post-keynesian models.
He highlights how, despite the strikingly similar formal structure, expressed by means of a "complementarity" problem, i.e. a set of non-linear weak inequalities, the four models imply profoundly different visions about the way an economic system works. He argues that the intrinsic difference between a neoclassical and a Keynesian model is not the allowance for unemployment of the latter, which can also be included in the former. The actual difference consists in the fact that or the neo-classical model the "Say's law" holds, while it does not for the Keynesian model. In other words, the "aggregated demand may never be deficient" as the supply "automatically" generates it. Unemployment, if present, is essentially generated within the labour market by some labour markets imperfections. Instead, in the Keynesian world, factor unemployment is essentially generated by the lack of effective demand. "Bastard Keynesian" models, are such that they work as a Keynesian model, through the working of the Keynesian multiplier, as an expansion of the autonomous demand, e.g. investment, generates an expansion of the labour demand and a contraction of unemployment. This happens until the full employment is reached. Beyond this point, these models work as neo-classical models, where the increase of investment occurs only at the expenses of consumption. Structuralist post Keynesian models, according to Missaglia, are essentially based on four assumptions: 1) in the short run there are almost no possibilities to substitute among factors; Leontief production functions are the only meaningful representations of the technology. 2) Income distribution is not determined by factors' productivity but by social and institutional aspects. 3) Some markets are not competitive and agents are price-makers (e.g. mark-up pricing). 4) The Say's law does not apply and aggregate demand matters to determine the level of output, factor use and welfare.
Stock-flow consistent post-keynesian models depict more realistic features of actual economic systems by explicitly introducing money (cash) as an asset. Cash, generated by the government to finance its deficit is held by the households as an asset at the beginning of each period. Cash is used, together with part of the income generated in

[127] Dixon, P.B, Parmenter, B.R., Sutton, J. and Vincent ,D.P. (1982). ORANI A multisectoral model of Australian economy. North Holland, Amsterdam.
Deardorf A.V. and tern R.M. (1986). The Michigan model of world production and trade: theory and applications. Cambridge. MIT press.
Taylor L. (1990). Structuralist CGE models, in Taylor L. (ed) ; Socially relevant Policy Analysis: Structural comptable general equilibrium models for developing world . Cambridge (MA): MIT press pp. 1-70.
[128] Missaglia M. (2011). Neoclassical and Keynesian macro-models: Thinking about the special case. University of Pavia,(It). MIMEO

the period to purchase goods and services. This Allows breaking the link between consumption-investment in one period and income generation in the same period.

Also Thissen (1998)[129], among others, attempts a classification of CGEs. He substantially adheres to the classification provided by Willenbockel, but put more emphasis on the different macro-economic closures, that, in line with Lance Taylor, imply substantially different ways of conceiving the causal relationships in the economic system and essentially determine the quantitative results of the models.

The issue of macro-economic and factor-market closures in general equilibrium models was firstly addressed by Sen (1963)[130]. With a simple five-equation model, namely: 1) a production function (homogeneous of degree 1, output *X* as a function of labour *L* and capital stock *K*), 2) a wage function (wage *w* equal to marginal productivity of labour), 3) a "zero-extra-profit" function (total wages and profits π absorb all the product, .4) a saving-investment balance (savings determined by different propensities to save of recipients of wages s_w w.r.t. recipients of profits s_π), and 5) an investment equation setting an exogenous investment level $I = I^*$), he highlighted that in general, it is not possible to determine an equilibrium solution if one wants to simultaneously achieve full employment of factors (as reflected by adding equations 6 and 7 to the system). This is due to the fact that only six variables are left to play with (namely *X,* π, *w*, *I, L, K*) for satisfying seven equations (see also Rattsø 1982)[131]. The system s represented as follows:

$$X = X(K, L) \quad (1)$$

$$w = \frac{\partial X}{\partial L} \quad (2)$$

$$X = \pi + wL \quad (3)$$

$$I = s_\pi \pi + s_w wL \quad (4)$$

$$I = I^* \quad (5)$$

$$L = L^* \quad (6)$$

$$K = K^* \quad (7)$$

Sen himself, on the basis of existing literature, outlined four possible ways forward, which reflect different visions on how an economic system adjusts to exogenous shocks:

1. The "*Neo-classical system*" (closure). In this model, equation (5) is dropped, leaving the real investment to be "savings-driven" (equation 4). This model solves quite easily by replacing available factor endowments (equations 6 and 7) into the

[129] Thissen M. (1998): A classification of empirical CGE modelling, p.9. SOM Research Report 99C01, University of Groningen, The Netherlands.

[130] Sen, A. (1963): "Neo-classical and neo-Keynesian theories of distribution" Economic Record, March 1963, pp 53-64.This simplified one-commody tmodel is in real terms, i.e. the price of the commodity X is set to 1. *w* is expressed as the quantity of commodity *X* per unit of labour.

[131] We follow here the structure of the system with seven equations and six variables, as proposed in Rattsø J (1982). "Different Macroclosures of the original Johansen model and their impact on policy evaluation". Journal of policy modelling 4(1): 85-87,
rather than the one originally proposed by Sen of five equations (1 to 5) and four variables, where equations 6 and 7 are reported only in the text of the article but not included in the system.

production function (equation 1) which determines the physical output X[132]. The wage w is also determined by means of the equation (2), based on the position reached on the production function when fully employing the factor endowments. Once X and w are determined, and given L, π is worked out thanks to equation (3). Subsequently, by means of equation (4), savings are determined. Finally, even if it is not explicitly modelled, it is assumed that there is some mechanism bringing savings and investment in equilibrium, such as the interest rate, which is assumed to be positively linked to savings and negatively linked to investment.

2. The "*Post-Keynesian system*" (closure), or "Kaldorian" closure, from Kaldor (1955)[133]. Equation 2 is dropped, so that the real wage is no longer forced to reflect the marginal productivity of labour. In addition, the saving rate of profits is assumed to be higher than the saving rate of wages: $s_\pi > s_w$.

Assume for example an increase in investments, due e.g. to increased expectations about future profitability[134]. According to Robinson (1989)[135] and Sen himself, this model adjusts through an income distribution mechanism, which allows reaching the Savings-Investment balance by altering the share of product allocated to profits. This is apparent when working out the share of profits in the total product, as expressed by Kaldor, starting from the above equations. First, note that the product allocated to wages wL in equation 4 can be expressed as the total product X minus the quantity of product allocated to profits:

$$wL = (X - \pi) \qquad (8)$$

Replacing the (8) into the (4) yields:

$$I = s_\pi \pi + s_w (X - \pi) \qquad (4a)$$

which can be expressed as:

$$I = s_\pi \pi + s_w X - s_w \pi$$

$$I = s_w X + \pi (s_\pi - s_w)$$

Working out the profits, leads to:
$$\pi (s_\pi - s_w) = I - s_w X$$

---

[132] An alternative "neoclassical" closure for an open-economy model is proposed in:
Taylor L. And Lysy F.J (1979): Vanishing Income redistributions: Keynesian clues about model surprises in the short run. Journal of development economics, 6, (1979) 11-29, North Holland., where L is endogenously determined due to the fact factor prices are determined on the basis of international prices and existing technology, assuming that value added and intermediate (imported) inputs combine in fixed proportions.

[133] Kaldor N. (1955): "Alternative theories of distribution". The review of economic studies. Pp 83-100.

[134] In the Keynesian world, profitability expectations are among the driving forces of investments.

[135] Robinson S. (1989) Multisectoral models, (chapter 18) in Handbook of development economics, Elsevier

$$\pi = \frac{I}{(s_\pi - s_w)} - \frac{s_w X}{(s_\pi - s_w)} \qquad (9)$$

Dividing by X leads to the share of profits on total product:

$$\frac{\pi}{X} = \frac{I}{(s_\pi - s_w)X} - \frac{s_w}{(s_\pi - s_w)} \qquad (10)$$

The (10) is the "Post-Keynesian" (Kaldorian) equation for the profit share (see also Pasinetti, 1962)[136].

Note that, as in this specification of the "Kaldorian" framework there is full employment of factors, i.e. equations (6) and (7) hold, given the technology, i.e. equation (1), also the output X is determined at the level:

$$X^* = X(K^*, L^*) \qquad (1a)$$

Assume that for I = I*, through the solution of the system of equations above it is possible to define equilibrium profits π^*. In equilibrium, as the saving shares are given, this implies that there will be a corresponding income distribution given by:

$$\frac{\pi^*}{X^*} = \frac{I^*}{(s_\pi - s_w)X^*} - \frac{s_w}{(s_\pi - s_w)} \qquad (10a)$$

Assume now that investments shift from I^* to:

$$I^{**} = I^* + \Delta I \qquad (5a)$$

As the output is fixed (given the technology and factor endowments), the economic system will adjust through a shift of product from consumption to investment, or, analogously, from consumption to savings. Given that saving rates are fixed, this can happen only by means of a shift of income between wages and profits, so that, thanks to the (10a), a new profit-product ratio $\frac{\pi^{**}}{X^*}$ will be determined:

$$\frac{\pi^{**}}{X^*} = \frac{I^* + \Delta I}{(s_\pi - s_w)X^*} - \frac{s_w}{(s_\pi - s_w)} \qquad (10b)$$

Developing the (10b) leads to:

[136] Pasinetti L.(1962): Rate of profits and income distribution in relation to the rate of economic growth. The review of economic studies, vol. XXXIX n.4, Oct 1962 pp.267-279. Pasinetti associated specific saving rates not to the sources of income (profits and wages) as done by Kaldor, but to the social classes (workers and capitalists). He observed that, as the model envisages savings of the workers, the workers will necessarily receive a share of profits for their savings by lending them to capitalists at an interest rate *i*. By introducing the profits of the workers and assuming that in the long run the interest rate equals the profit rate, he worked out a simplified expression for the profit share:

$$\frac{\pi}{X} = \frac{I}{s_\pi X}$$

$$\frac{\pi^{**}}{X^*} = \frac{I^*}{(s_\pi - s_w)X^*} - \frac{s_w}{(s_\pi - s_w)} + \frac{\Delta I}{(s_\pi - s_w)X^*}, \qquad (10c)$$

i.e., after substituting the (10a) in the (10c), leads to:

$$\frac{\pi^{**}}{X^*} = \frac{\pi^*}{X^*} + \frac{\Delta I}{(s_\pi - s_w)X^*}, \qquad (10d)$$

Or also:

$$\pi^{**} - \pi^* = \frac{1}{(s_\pi - s_w)}\Delta I$$

Calling $\pi^{**} - \pi^* = \Delta\pi$

Leads to:

$$\Delta\pi = \frac{1}{(s_\pi - s_w)}\Delta I \qquad (11)$$

The (11) can be considered the multiplier of profits in the Kaldorian framework (with full employment).

The adjustments to a shock in a component of the aggregated demand in an actual economic system which presents the stylized features above, following Thissen (1998)[137], if nominal wages are fixed for some institutional reasons, may occur through the increase of the general level of prices. This increase is due to the pressure on the demand side, which cannot be satisfied, given the full employment of factors. This leads to a reduction of the real wages and a related upward shift of profits, which in turn generates additional savings to compensate for the increase in investments[138].

3. The "Johansen" system (closure). In the Johansen approach[139], the equation (4) is dropped. At a first sight, it may appear that the Saving-Investment balance is dropped. In actual facts, equation (4) can be re-written introducing one more equation (4c) and one more variable (*S*) in the system as:

$$S = s_\pi \pi + s_w wL \qquad (4b)$$

$$S = I \qquad (4c)$$

What is dropped is the (4b), i.e. the equality between savings and "voluntary" savings based on incomes. This implies that there may be in the system other sources of

[137] Thissen M. (1998): A classification of empirical CGE modelling, p.9. SOM Research Report 99C01, University of Groningen, The Netherlands.

[138] Note that it is assumed here that, for some institutional reasons the employment supply does not drop as a consequence of a reduction of real wages, thus allowing the system to keep the same level of output *X**.

[139] Firstly introduced by Johansen, Leif (1960): "A multi-sectoral Study of economic growth". Amsterdam, North-Holland (2nd enlarged edition, 1974). An early review and discussion of alternative macro-economic closures is also found in Rattso, J (1982): "different Macroclosures of the Original Johansen Model and Their Impact on Policy Evaluation". Journal of Policy Modelling 4(1) p.85-97.

(positive or negative) savings, e.g. the government, so that equation (4b) can be re-written as:

$$S = s_{\pi}\pi + s_{w}wL + GSAV \qquad (4d)$$

where *GSAV* is the new endogenous variable which completes the savings account. Note that the system has now eight variables (*X,* π, *w*, *I, L, K, S, GSAV*) and eight equations, notably:

$$X = X(K, L) \qquad (1)$$

$$w = \frac{\partial X}{\partial L} \qquad (2)$$

$$X = \pi + wL \qquad (3)$$

$$S = I \qquad (4c)$$

$$S = s_{\pi}\pi + s_{w}wL + GSAV \qquad (4d)$$

$$I = I^{*} \qquad (5)$$

$$L = L^{*} \qquad (6)$$

$$K = K^{*} \qquad (7)$$

This implies that investments can be funded with resources not necessarily generated by voluntary savings of economic agents but with some sort of external resources. Setting investment exogenously implies allowing the system to generate an endogenous imbalance in the saving account, as if the economic system were able to borrow from or lend to an external agent.

However, the system can be modified with the introduction of two new endogenous variables, notably the tax rate *t* and the government revenue *GREV* and two new equations, i.e. the government revenue equation (12) which defines the government revenues as the sum of taxes on profits and wages, and the government account balance, which sets the equality between government revenues where government revenues and *GSAV*, i.e. the allocation of the government to fill the gap of private savings, making explicit in this simplified model the role of the government as "generator" of the "compulsory" savings to fill the gap with respect to the "voluntary" income-based savings. This implies that the government absorbs a share of the remuneration of factors, forcing the savings of the system up to a point where they are enough to fund the exogenous level of investment:

$$GREV = t\pi + twL \qquad (12)$$

$$GREV = GSAV \qquad (13)$$

Also equation (4d) needs now to be modified to reflect the fact that "voluntary" savings are now based on factor remunerations net of taxes:

$$S = s_\pi \pi(1-t) + s_w wL(1-t) + GSAV \qquad (4e)$$

This implies that there is an endogenously determined tax rate which matches mandatory plus "compulsory" savings with exogenously set investments.

The whole system looks now as follows[140]:

$$X = X(K, L) \qquad (1)$$
$$w = \frac{\partial X}{\partial L} \qquad (2)$$
$$X = \pi + wL \qquad (3)$$
$$S = I \qquad (4c)$$
$$S = s_\pi \pi(1-t) + s_w wL(1-t) + GSAV \qquad (4e)$$
$$I = I^* \qquad (5)$$
$$L = L^* \qquad (6)$$
$$K = K^* \qquad (7)$$
$$GREV = t\pi + twL \qquad (12)$$
$$GREV = GSAV \qquad (13)$$

Note that here, π and wL represent now gross profits and wages.
If we assume an external upward shift on the investment demand as illustrated for the case of the "post-keynesian" (Kaldorian) model, the "Johansen" system adjusts by:

1) maintaining the output level as determined by the full employment of factor endowments (equations 1, 5 and 6);
2) setting the gross remuneration of factors as per equations (3) and (4c)
3) assuming that the government adjusts the tax rates (and related spending) in such a way of generating enough savings (positive or negative) to compensate for the exogenous shock on investments;
4) Shifts in the tax rates adjust disposable incomes in such a way that the private consumption of goods reduces bring in equilibrium the commodity market, allowing for increased investment demand.

4. The "Keynesian" system (closure). In general terms, the Keynesian approach to economic development in setting the level of production gives prominence to the role of the "effective demand" (Keynes J.M.,1936)[141], rather than to the role of fully-

[140] Note that substituting the (13) into the (12) and then the (12) into the (4e) leads to: $S = s_\pi \pi(1-t) + s_w wL(1-t) + t\pi + twL$. After factoring profits and wages, it can be written as: $S = \pi[s_\pi(1-t) + t] + wL[s_w(1-t) + t]$, which highlights as saving rates are now composed by voluntary component $s_\pi(1-t)$ and $s_w(1-t)$ respectively for profits and wages, and a "compulsory" component *t*.

[141] Keynes J.M.(1936) The general theory of employment, interest and money. Electronic version, at http://homepage.newschool.edu/het//texts/keynes/gtcont.htm. "*Given the propensity to consume and the rate of new investment, there will be only one level of employment consistent with equilibrium; since any other level will lead to inequality between the aggregate supply price of output as a whole and its aggregate demand price. This level cannot be greater than full employment, i.e. the real wage*

employed factor endowments. Full employment will be reached only if the demand for investment equals the excess supply left after satisfying the demand for private consumption when all the labour is fully employed. This is a special case that can only exist "*by accident or design*", as, in all the other cases, the level of (expected) effective demand will not be such to induce entrepreneurs to employ all the available labour. This conceptual framework justifies dropping equation (6) from the above system of equations, allowing the actual level of employment to be endogenously determined. However the system has now more endogenous variables than equations, In addition the equilibrium between investment and savings is no longer achieved by means of an endogenous tax rate, as in the Johansen system, but by shifts in real income which alter the volume of savings. Equation (6) can therefore be replaced by equation (14) which determines tax rate. Therefore, the whole system, which presents ten equations and ten endogenous variables (*X,* π, *w*, *I, L, K, S, GSAV,GREV, t*), becomes:

$$X = X(K, L) \quad (1)$$

$$w = \frac{\partial X}{\partial L} \quad (2)$$

$$X = \pi + wL \quad (3)$$

$$S = I \quad (4c)$$

$$S = s_{\pi}\pi(1-t) + s_{w}wL(1-t) + GSAV \quad (4e)$$

$$I = I^{*} \quad (5)$$

$$K = K^{*} \quad (7)$$

$$GREV = t\pi + twL \quad (12)$$

$$GREV = GSAV \quad (13)$$

$$t = t^{*} \quad (14)$$

Following the conceptual framework set in Pasinetti (1974)[142], in the Keynesian world, an exogenous upward shift in the investment demand due e.g. to an increase of expected profitability of investments[143], determines an increase of the output, thus of the income, by means of multiplier effects.

To highlight the causality links above, the system is rewritten, making the effective demand explicit in its components: private consumption, investment and public

---

cannot be less than the marginal disutility of labour. But there is no reason in general for expecting it to be equal to full employment. The effective demand associated with full employment is a special case, only realised when the propensity to consume and the inducement to invest stand in a particular relationship to one another. This particular relationship, which corresponds to the assumptions of the classical theory, is in a sense an optimum relationship. But it can only exist when, by accident or design, current investment provides an amount of demand just equal to the excess of the aggregate supply price of the output resulting from full employment over what the community will choose to spend on consumption when it is fully employed" Ch 3, p.23

[142] Pasinetti L. (1974): *The economic theory of effective demand*, in: *Growth and income distribution. Essays in economic theory*. Cambridge, Cambridge University Press, 1974, pp. 60-63 and the appendix on the "delayed multiplier".

[143] In the full framework, Keynes introduces the interest rate, determined by the quantity of money and the preference for liquidity of people. Here the interest rate determination is not modelled, so the analysis assumes it as a given.

consumption[144]. Note that equation (15) replaces equation (4c), i.e. the "forced" equality between savings and investment. Equation (15) states that the total production is absorbed by private consumption *C*, investment and government consumption *G*. Note also that *C* and *G* are two new variables in the system, implying that two new equations are needed to "square" the system. Thus, equation (16), which defines private consumption as a (linear) function of disposable (i.e. net of taxes) income, is added. Note that in (16) private consumption is the sum of the share of wages and the share of profits allocated to consumption, defined as the complements to 1 of the shares of savings. In addition, the government consumption is assumed to be set exogenously (equation 17) and the public savings are now the bsalance between government revenue and government expenditure (equation 13a). The system has now 12 equations and 12 variables (*X,* π, *w*, *I, L, K, S, GSAV,GREV, t, C* and *G*). Therefore although the equations solve simultaneously, the Keynesian closure implies the following causality link:

> exogenous shift of the effective demand (e.g. investments) (equation 5) → determination of the output level (equation 15)→ determination of income (equal to output in closed systems) → determination of factor use (equation 1) and income allocation (equations 2 and 3) → determination of private consumption (equation 16) (back again to equation 15 through the multiplier effects → determination of savings.

$$I = I^* \quad (5)$$
$$X = C + I + G \quad (15)$$
$$X = X(K, L) \quad (1)$$
$$w = \frac{\partial X}{\partial L} \quad (2)$$
$$X = \pi + wL \quad (3)$$
$$C = \pi(1-t)(1-s_\pi) + wL(1-t)(1-s_w) \quad (16)$$
$$S = s_\pi \pi(1-t) + s_w wL(1-t) + GSAV \quad (4e)$$
$$K = K^* \quad (7)$$
$$GREV = t\pi + twL \quad (12)$$
$$GREV = G + GSAV \quad (13a)$$
$$t = t^* \quad (14)$$
$$G = G^* \quad (17)$$

In this framework, savings passively adapt to investment. This can be shown as follows:

replace (3) and (16) into (15), to get:

$$\pi + wL = \pi(1-t)(1-s_\pi) + wL(1-t)(1-s_w) + I + G \quad (15a)$$

Subtract to both sides of the equation (15a) equation (12) after substituting into that equation the (13a):

[144] Public consumption and taxes are not strictly necessary to explain the causal links in the Keynesian system, but are left for the sake of comparability with the previous case and for completeness.

$$\pi + wL - t\pi - twL = \pi(1-t)(1-s_\pi) + wL(1-t)(1-s_w) + I + G - G - GSAV \quad (15b)$$

By transporting to the LHS all the elements of the RHS but investment, we get:

$$\pi + wL - t\pi - twL - \pi(1-t)(1-s_\pi) - wL(1-t)(1-s_w) + GSAV = I$$

With some manipulations on the LHS we get:

$$\pi(1-t) + wL(1-t) - \pi(1-t)(1-s_\pi) - wL(1-t)(1-s_w) + GSAV = I$$

$$\pi(1-t)(1-1+s_\pi) + wL(1-t)(1-1+s_w) + GSAV = I$$

Which reduces to:

$$s_\pi \pi(1-t) + s_w wL(1-t) + GSAV = I \quad (15c)$$

Equation (15c) states the equality between total savings (private and public) as defined in equation (4e) and investment. Making use of equations (11) and (14) leads to:

$$s_\pi \pi(1-t^*) + s_w wL(1-t^*) + GSAV = I^* \quad (15d)$$

This implies that the equality between savings and investment is obtained by the solution of the abovementioned system for any level of investment, savings and fiscal decisions, by means of the determination of appropriate levels of income, labour utilization and income distribution between profits and wages (equation 3). Table 1 summarizes the main features of the different models considered above.

Table 1 Main features of alternative economic models

Elements	**Neo-classical**	**Keynesian**	**Johansen**	**Post- Keynesyan** (Kaldor-Pasinetti)
Output	Determined by factor endowments and technology	Determined by the effective demand	Determined by the effective demand	Determined by the effective demand (or by factor endowments if full employment is reached)
Investment	Endogenous Investment adapts to savings	Exogenous. Savings adjust to investments by means of changes in quantities and incomes (multiplier)	Exogenous. Savings adjust to investment by means of "compulsory" savings (taxes)	Exogenous. Income distribution adapts to adjust savings
Factors	Full employment	May be unemployed	Full employment	May be unemployed
Wages	Reflects MVP	May not reflect MVP	Reflects MVP	May not reflect MVP

4. Applying general equilibrium models for actual decision making

In the light of the findings illustrated in the previous sections, when applying general equilibrium models to actual cases it is important to carefully analyze the macro-economic context and the factor endowments of the economic system. This relates for instance to the quantity and type of labour available, to the way labour markets work (or don't work), in particular to their degree of geographic or qualitative segmentation, the level and causes of unemployment as well as to the way wages are determined in the specific institutional context. Analogous considerations hold for other factors such as capital or natural resource endowments such as land, water, mineral and other environmental assets. It is also important considering the degree of substitutability among various factors and the time span in which some substitutability could actually occur. Regarding the macro-economic context, it is important to understand the ways through which the macro-economic balances would be restored after the simulated shock and to what extent the country under investigation has the possibility to increase or decrease the balances of the macro-economic accounts, notably, the external debt and the government deficit.

To understand the extent to which the different assumptions regarding the way an economic system works affect the model results, and, by way of consequence, policy making decisions, a simple general equilibrium model has been built. The model, whose main features are illustrated in the next section, has then been applied to an "archetypical" (simplified) less industrialized economy.

4.1. A one-sector, two-household, two-factor general equilibrium model

For illustrative purposes, the simple model refers to a one-sector, two-household, two-factor economy, open to international trade. The economy is "small" i.e. the country to which the model refers to is a price taker on international markets, which implies that the prices of imports and exports are set exogenously. The summary features of the model, including equations, endogenous and exogenous variables are represented in table 1.

In the system, commodities flow from the producer to consumers, while services flow in the opposite direction. Flows of goods and services are countervailed by flows of payments. The commodity flow within the system is represented in figure 4. A domestic producer produces the one-commodity domestic output X , whose quantity is QX, sold at price PX , by means of one intermediate input, (the "composite" consumption good available in the system Q, whose quantity is QQ, bought at price PQ), and a factor aggregate (value added), combined by means of a "Leontief" technology, i.e. in fixed proportions with the output. The factor aggregate is obtained by combining labour services L, bought at price WL plus taxes on labour (social charges, etc) at a tax rate tl, and capital services K, bought at price WK, by means of a Constant-Elasticity of Substitution (CES) production function[145]. The domestic producer operates under a "zero-profit" condition. The producer demands labour up to a point where the marginal value product of labour equates the labour wage. The same applies to capital. Equations G, H and I in table 2 set the behaviour of the producer and impose the zero-profit condition.

The one-commodity domestic output X is both sold on the domestic market and exported. However, imperfect transformation between the domestic and exported commodity is assumed. Quantities to be sold domestically and exported are set to figuratively maximize profits of a "*transformer*", who buys the domestic output and transforms it in the export good E, where QE and PE are respectively the quantity and price of E, and in the domestic good DD, with QDD and PDD respectively the quantity and price of DD . This "transformation" occurs on the basis of relative domestic versus export prices and a Constant Elasticity of Transformation (CET) function, which establishes how one unit of domestic output can be transformed either in the domestic good or in the export good. The "*transformer*" operates under a "zero-profit" condition. PE is set as the international price of the exported good PWE times the exchange rate EXR, which is the price of one unit the foreign currency in domestic currency (units of domestic currency per one unit of foreign currency). Equations L,

[145] More complex production functions could be chosen which embody other types of capital services, such as human capital, natural resources such as land and water, or even immaterial assets, such as the quality of institutions. Implications of policies affecting the endowments and services of these resources, including policies to reinforce institutions would directly affect the domestic product. In this simple example, we consider only capital services and labour services to focus the attention on factor market and macro-closures, rather than on specific factors. In actual CGE models however, the extent to which factors actually affecting the production are included, influences the degree of adherence of the model to the reality and, by way of consequence, the usefulness of model results for actual policy making.

M, N and O set respectively the price of exports, the supply of exports, the supply of domestic good and the zero-profit condition of this figurative transformation process.

The domestic good *DD* however, is not directly consumed by the final consumers. The economic system also imports good the good *M*, where *QM*, and *PM* are respectively the quantity and price of *M*. *PM* is based on the international price of imports *PWM*, the exchange rate and a tariff rate on imports. Consumers demand the composite consumption good *Q*, where *QQ*, and *PQ* are respectively the quantity and price of *Q*. *Q* is a mix of imported and domestic goods, as the domestic and the imported goods are only imperfectly substitutable. The domestic good is therefore figuratively aggregated with the imported one by a "*processor*". The mix is set to figuratively minimize the cost of the "*processor*", on the basis of the price of the domestic good relative to the price of the imported good and a Constant Elasticity of Substitution (CES) function[146], establishing which quantities of import and domestic good are required for one unit of composite consumption good. Also the "*processor*" operates under a "zero-profit" condition. Equations P, Q, R and S in table 2, set respectively the price of imports, the demand of imports, the demand of the domestic good and the zero-profit condition of this figurative aggregation process.

[146] This CES function in the literature is referred as the "Armington" function:
Armington, P, (1969), A Theory of Demand for Products Distinguished by Place of Production. International Monetary Fund Staff Papers, XVI (1969), 159-178.

Figure 3. Production, transformation and processing of goods in the one-sector CGE.

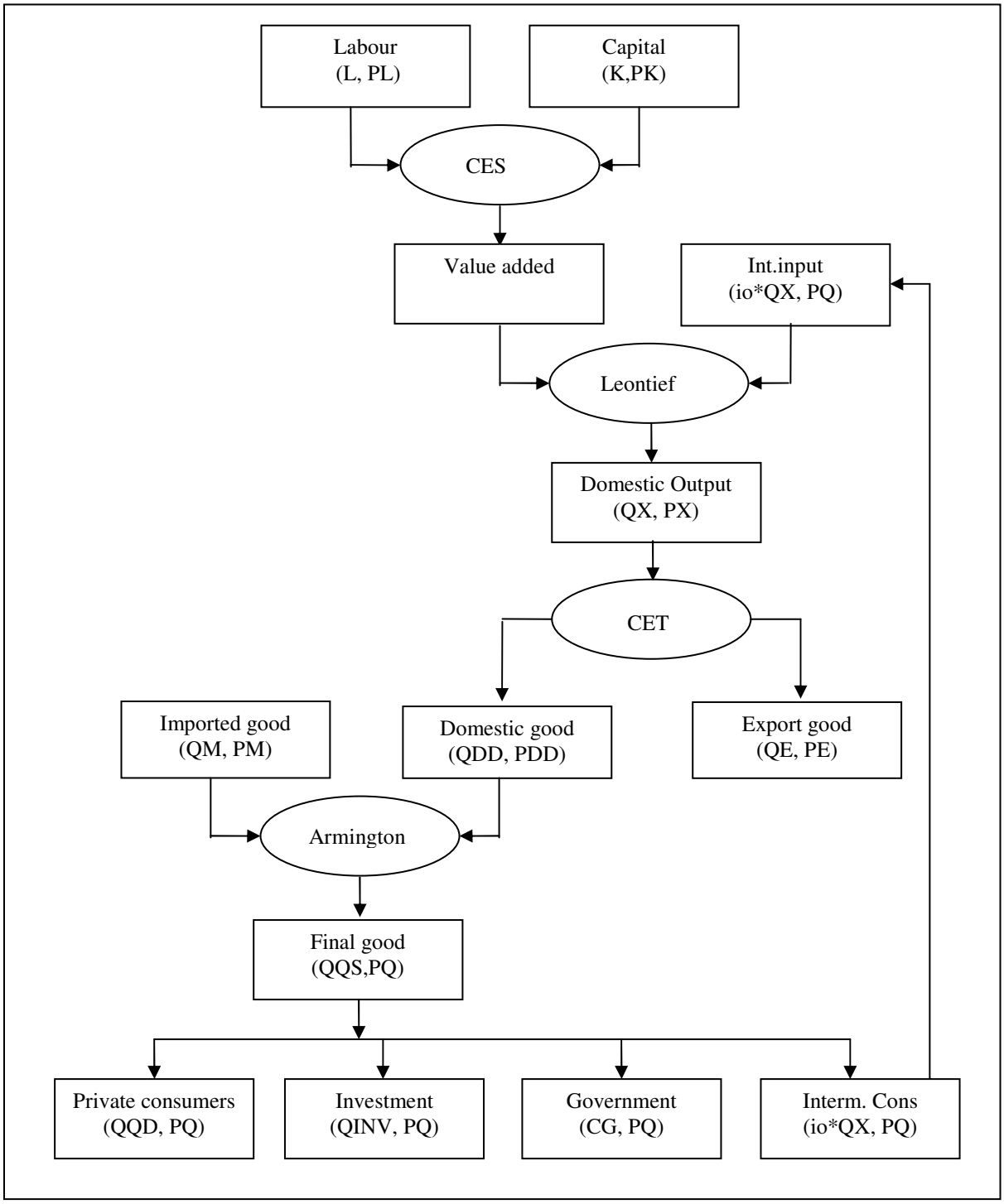


Table 2. A one-commodity, two-households open-small country general equilibrium model

Eq.code	#Eq	Description of the equations	Functional form	#Var	Endogen. var.	Exogenous var.	Notes
		Households' consumption and supply of factors					
A	2	Household demand of good QQh	QQh*PQ*(1+tcon) = EXPh	5	QQh, EXPh, PQ	Beta = 1, tcon	One-good LES (share =1)
B	4	Households' expenditure EXPh	EXPh=Yh*(1-tins)-SAVh	7	SAVh	tins	
C	6	Income of households Yh	Yh=*Yh*(WK,QKSh,WL,QLSh, UNEMPh, REMFCh, EXR TRGh, CPI, INTRAh)	16	WL,WK,UNEMPh Yh, EXR, INTRAh	QKS, QLS, REMFCh TRGh,CPI	Labour income net of UNEMP
D	7	Labour price WL	WL=*WL*(PLF, EXR)			PLF, b (lab.mobility)	
E	8	Consumer Price Index CPI	CPI=CPI(PQ,QQ)				CPI = 1 is the numeraire
F	10	Household savings SAVh	SAVh = apsh*Yh*(1-tins)			apsh, tins	apsh: average prop.to save
F1	11	Equat.setting sum of intrah.transf.=0	INTRA1= - INTRA2				
		Producer of the basic good					
G	12	Demand of capital of the domestic producer QK	QK=#CES(QX, WK, WL)	18	QK, QX	CES parameters	CES-based factor demand
H	13	Demand of labour of the domestic producer QL	QL=#CES(QX, WK,WL)	19	QL	CES parameters	CES-based factor demand
I	14	Zero profit condition of the domestic producer	PX*QX = WK*QK + WL*QL + io*QX*PQ	20	PX	io (technical coeff.)	QX is the prod.of dom.output
		Government					
J	15	Total government revenue GOVREV	GOVREV=Y*tins+QQ*PQ*tcon+QM*PWM* EXR*tm + QL*WL*tl+FTRANSF*EXR	21	GOVREV	tm, tl (tax rates) PWM, FTRANSF	
K	16	Government expenditure GOVEXP	GOVEXP = CG*CPI + TRF*CPI	23	GOVEXP, CG	TRF	The gov.exp.is exogenous
		Import export					
L	17	Price of exports PE	PE = PWE * EXR	24	PE	PWE	
M	18	Supply of exports QE	QE = #CET(QX, QDD, PE, PDD)	27	QE, QDD, PDD	CET parameters	From the CET
N	19	Supply of the transformed good QDD	QDD = #CET(QX, QE, PE, PDD)			CET parameters	QDD goes from CET to CES
O	20	Zero profit condition for the CET (the transformer)	PX*QX = PDD*QDD + PE*QE				
P	21	Price of imports PM	PM=(1+tm)*PWM*EXR	28	PM	PWM	
Q	22	Demand of imports QM (Entering the CES)	QM = #CES(QQ, QDD, PM, PDD)				QM enters the CES
R	23	Demand of the transformed good QDD	QDD = #CES(QQS, QM, PM, PDD)	29	QQS		QDD goes from CET to CES
S	24	Zero Profit Condition for the CES (the "processor")	QQS*PQ = PM*QM + QDD*PDD				Armington CES aggregator
		Market clearing and Macro closures					
T	25	Labour market equilibrium	QL = QLS - UNEMP				
U	26	Allocation of unemployment to households	UNEMP1= LABSH1 * (UNEMP2/LABSH2)			LABSHh	LABSH1+LABSH2 = 1
W	27	Capital market equilibrium	QK= QKS				
X	28	Comodity market equilibrium	QQ + QINV + ioQX + CG = QQS	30	QINV		
Y	29	Trade balance	QM*PWM=QE*PWE+FSAV+FTRANSF+REMFC	31	FSAV		
Z	30	Savings - Investment balance	QINV*PQ = SAV + GSAV + FSAV*EXR			GSAV	
AA	31	Government buget balance	GOVR - GOVEXP - GSAV = WALRAS	32	WALRAS		WALRAS = 0 always

In the table, variables referenced with the suffix h refer to each of the two household (h = 1, 2). The same variable without suffix refers to the sum across h. For simplicity, the table does not report neither the variables referring to the total across households as endogenous variables, nor the equations which set the totals across households, for instance, the table does not report neither the variable *SAV* (total household savings) among the endogenous variables nor the equation *SAV=SAV1+SAV2* among the equations of the model.

Consumers demand the final composite good quantity *QQ* at the price *PQ* plus taxes on consumption at a tax rate *tcon* (equation A). A consumer price index CPI is created (equation E). Hoewever, being a one-good model, the CPI coincides with the price composite consumption good *PQ* . As the model is expressed in real terms, the CPI is chosen as the numeraire of the other prices and incomes and set equal to one. Each Household receive its income *Yh* (equations C) by selling labour and capital services, through remittances *REMFCh* from abroad, transfers from the government *TRGh* and intra-household transfers *INTRAh*. Expenditure *EXPh* on the final good for each household is set as income net of income taxes minus household savings *SAVh* (equartions B). Savings are calculated as net income times the average propensity to save, *aps* which is household specific (equation F).

The labour supply *QLSh* is household-specific and exogenous. It includes also a foreign labour component *LFh*, exogenous as well, which gives rise to remittances. Remittances, based on the prevailing labour wage rate abroad, are received in foreign currency and converted in domestic currency by means of the exchange rate.

The wage is endogenously set, the producer uses all the available labour, and the wage adjusts to a point where it equates the marginal value product of labour. The same applies for capital. This is imposed in the model by the equations of "optimal" demand of factors (CES-based). However, in its general form, the model is set in such a way that unemployment and exogenous wage setting (equation D) are allowed. If the wage is forced below its marginal value product, given the zero profit condition of the producer, the remuneration of capital increases above its marginal value. Vice-versa, if the wage is forced above its marginal value, the producer reduces its labour demand up to a point where the equality of the labour wage with its marginal value product is restored. This leaves part of the labour supply unallocated, giving rise to unemployment (labour clearing, equation T). In this case, the total unemployment *UNEMP* is allocated to households in fixed proportions, reflecting employment at the benchmark (Equations U). This implies that the labour income is given by the household supply of labour (exogenously set), net of its foreign component and unemployment (when it occurs), times the labour wage rate. In the model, the domestic labour wage is assumed to be determined on the basis of the prevailing wage in a closely related foreign labour market, assuming that there exists some institutional mechanisms allowing workers to push wages above the marginal value product of labour whenever the wage abroad, possibly adjusted to reflect the different working conditions and the degree of labour mobility, exceeds the domestic wage. The reverse applies for employers, when the foreign wage is lower than the domestic one.

Taxes on income, consumption, imports and labour are collected by the government, which receives also transfers *FTRANSF* in foreign currency from abroad (foreign aid, exogenously set). The sum of taxes and foreign transfers gives the government revenue *GOVREV* (equation J). Government expenditure *GOVEXP* comprises the demand *GC* of the composite final good *QQ*, and monetary transfers from the government to households *TRG*, both set exogenously and fixed in real terms (equation K).

The remaining equations are market clearing conditions and macro-closures. The first ones comprise: the clearing condition of the capital market, where the demand for capital services *QK* is equated to the sum of the supply from the two households *LSK* (equation W), and the clearing condition of the composite final good *Q*, (equation X) where its supply *QQS* is equated to the sum of the demand for final private consumption *QQ*, the demand for investment *QINV*, the demand for intermediate consumption *ioQX* and the demand for the

government consumption *CG*. The macro-closures comprise: the current account balance (equation Y), where the inflows of foreign currency due to exports plus the inflows from foreign transfers and the remittances minus the outflows for imports is gives: – foreign savings (- *FSAV*) (positive foreign savings implies a deficit of the current account balance, while negative foreign savings implies a surplus), the government budget balance (equation Z), where the government savings *GSAV* result from the difference between government revenue and government expenditure and the Savings-Investment balance (equation AA), where the investment expenditure is equated to the sum of savings of households, the government savings and the foreign savings multiplied by the exchange rate.

This system comprises thirty-one equations and thirty-two endogenous variables, as reported in the sixth column of table 2. However, one equation is dependent from the others for the "Walras law".[147] A dummy "Walras" variable has been added to check for this dependency. Once calibrated on the Social Accounting Matrix (SAM) described in the next section, this system, will be adapted to test alternative macro and factor market closures and quantify relevant differences and related policy making implications[148].

4.2. An "archetypical" SAM of an aid-dependent less industrialized country.

The model described above has been calibrated on an aggregated Social Accounting Matrix (SAM) reflecting the one-year transactions of a foreign aid-dependent less-industrialized country[149]. This SAM is assumed to be an archetype of the SAMs of poor oil-dependent countries with little or no mineral or timber resources, which base their inflows of foreign currency mainly on exports of agricultural products, foreign aid and to a minor extent on remittances. The weakness of the export sector, associated to the need to import essential goods, including medical appliances, drugs, technology items, in addition to oil and other energy products s well as fertilizers, lead to recurrent annual deficits of the current account balance. Furthermore, due to the high level of poverty and to institutional weaknesses, taxation is kept at very low levels while expenditures to ensure a minimum of social services generate government budget deficits. The SAM's inflows and outflows and related structure, expressed as percentage of the totals of rows and columns respectively, are reported in table 3.

The main features of the "archetypical" aggregated and simplified SAM and the socio-economic system of reference are:

1. There is a single aggregated industry (activity) producing one aggregated commodity.
2. This commodity is both consumed domestically (96%) and exported (4%).
3. The same commodity is also used by the single industry as intermediate input, to produce the unique domestic commodity (34% of the total output produced).
4. The final consumers (households, the government and investors -the S-I account-) require the domestically produced commodity, but in addition require also that the commodity be imported. (87% and 13% respectively)
5. Factor income (labour wages and capital payments) are paid to households who provide services to the industry, as accounted by means of factor accounts.

[147] A dummy "Walras" variable has been added to check for this dependency.
[148] As the system is not "square", to be solved in its general form reported in table 2, one endogenous variable needs to be exogenously determined ("fixed").
[149] The SAM reported in table 3 is essentially based on the Social Accounting Matrix of Burkina Faso for the year 2000, adjusted and simplified for some accounts, such as tax accounts, inventories and payments from factor accounts to financial and non financial enterprises.

6. Households are classified as poor (*p*) and non-poor (*n*), on the basis of their consumption expenditure compared with a poverty line[150].
7. Factor income (value added) is very unequally distributed between poor and non poor. 85% of the factor income is paid to non-poor people. As they are around the 50% of the population, on average they receive around five times more income than the poor people.
8. Labour Wages (which include family labour) distribute only 37% of the value added, while the payments for capital services distribute 63 % of it.
9. The government budget significantly depends on external support (high dependency ratio), as 44% of its revenue comes from the Rest of the World (RoW) as "foreign aid". Despite these inflows, government savings are negative, showing a deficit of 22% of the total government inflows and affecting the S-I balance for -30% of the total savings.
10. Foreign aid constitutes 35% of the payments of the RoW to the country in the accounting period, the others being essentially loans (19%), signalling a deficit of the current account balance, payments for exports (33%) and remittances of migrants (13%)[151].

[150] In the real-case matrix of Burkina Faso, the classification was done on the basis of the "Survey on the household living standards" in Burkina Faso in 2003, by adopting an absolute poverty line for the period April-July 2003 The poverty line, calculated on the basis of minimum calories intake and minimum-non food requirements, amounts to 82,672 FCFA per person per year, corresponding to around one fourth of the legal minimum wage and around two fifths of the international poverty line of one dollar per person per day. On the basis of this poverty line 46.4% of the population, corresponding to around 37.5% of the households was classified as "poor" (INSD, 2003: Profile de Burkina Faso la Pauvreté en 2003. au, Ministère de l'Economie et du développement. Segretariat General, Insitut National de la Statistique et de la Démographie (INSD).

[151] Regarding the RoW account, the archetype SAM adopted here looks quite different form the "Social Accounting matrix for an archetype African Economy" chosen by Winters et al.(1996). There, no payments are recorded from the RoW to the S-I account (no foreign savings) and only 15.2 "Monetary Units-MU" over a total of 81.1MU of the RoW payments to the country (say, less than 19%) are paid to the government. Significant differences arise also in the share of value added distributed through wages, reported as 51%, compared with 37% in the SAM adopted here.

Winters, P., De Janvry A., Sadoulet E., Stamoulis K, (1996). The Role Of Agriculture In Economic Development: Visible And Invisible Surplus Transfers Department of resource economics working paper n 143.

Table 3. Structure of an "archetypical" less-industrialized aid-dependent economy

Panel A: Social accounting matrix

	Activity	Commodity	Factors		Insitutions			Saving-Inv.	Rest of the W.	
	OUTPUT	COUT	LABOUR	CAPITAL	HOUS. Poor	HOUS. Non-Poor	GOVERNMENT	S-I	RoW	Total
OUTPUT	-	2,822,877					-	-	-	**2,822,877**
COUT	1,149,125		-		279,296	1,162,520	398,493	279,655	149,849	**3,418,938**
LABOUR	623,663		-				-	-	-	**623,663**
CAPITAL	1,046,477		-				-	-	-	**1,046,477**
HOU. Poor	-	-	129,301	129,173	-	38,581	11,795	-	18,440	**327,289**
HOU. NP	-	-	494,362	917,304	2,570	-	34,511	-	42,886	**1,491,633**
GOVERNMENT	3,611	137,904			5,297	56,048			160,368	**363,228**
S-I		-			40,126	234,485	- 81,570		86,614	**279,655**
RoW		458,157								**458,157**
Total	**2,822,877**	**3,418,938**	**623,663**	**1,046,477**	**327,289**	**1,491,633**	**363,228**	**279,655**	**458,157**	

Panel B: Inflows' Structure

	Activity	Commodity	Factors		Insitutions			Saving-Inv.	Rest of the W.	
	OUTPUT	COUT	LABOUR	CAPITAL	HOUS. Poor	HOUS. Non-Poor	GOVERNMENT	S-I	RoW	Total
OUTPUT	-	100	-	-	-	-	-	-	-	100
COUT	34	-	-	-	8	34	12	8	4	100
LABOUR	100	-	-	-	-	-	-	-	-	100
CAPITAL	100	-	-	-	-	-	-	-	-	100
HOU. Poor	-	-	40	39	-	12	4	-	6	100
HOU. NP	-	-	33	61	0	-	2	-	3	100
GOVERNMENT	1	38	-	-	1	15	-	-	44	100
S-I	-	-	-	-	14	84	- 29	-	31	100
RoW	-	100	-	-	-	-	-	-	-	100

Panel C: Outflows' structure

	Activity	Commodity	Factors		Insitutions			Saving-Inv.	Rest of the W.
	OUTPUT	COUT	LABOUR	CAPITAL	HOUS. Poor	HOUS. Non-Poor	GOVERNMENT	S-I	RoW
OUTPUT	-	83	-	-	-	-	-	-	-
COUT	41	-	-	-	85	78	110	100	33
LABOUR	22	-	-	-	-	-	-	-	-
CAPITAL	37	-	-	-	-	-	-	-	-
HOU. Poor	-	-	21	12	-	3	3	-	4
HOU. NP	-	-	79	88	1	-	10	-	9
GOVERNMENT	0	4	-	-	2	4	-	-	35
S-I	-	-	-	-	12	16	- 22	-	19
RoW	-	13	-	-	-	-	-	-	-
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

4.3. Alternative macro-economic and factor market closures

The abovementioned SAM has been used to calibrate the one-sector two-household two-factor CGE, notably, the efficiency and the share parameters of the CES and CET functions and the calculation of selected exogenous variables (remittances, transfers etc). Elasticities of substitution for the Armington CES and the CET for domestic-export transformation have been kept in the range 1 to 3, as discussed in Taylor (2006)[152], notably most simulations have been run with: 1) Armington elasticity of substitution between *QDD* and *QM* = 1.75; and 2) Elasticity of transformation between *QDD* and *QE* = -1.75. However, one scenario provides a sensitivity analysis of the results to changes of the Armington elasticity, which is set at 0.75. The elasticity of substitution between capital and labour at the bottom of the technology nest (figure 3) has been set at 1.5.

No parameter was needed for the one-good LES consumer demand functions[153].

[152] Taylor L, Arnim von R. (2006) Modeling the impact of trade liberalization. A critique of computable general equilibrium models. P.21. Oxfam research report July 2006.

[153] With a one-good demand the issue of using price and expenditure elasticities compatible with Curnot and Engel aggregations reduces to imposing own-price elasticity and expenditure elasticity both equal to one. Also the issue of choosing the appropriate Frisch parameter compatible with own-price and income elasticities satisfying Curnot and Engel aggregation vanishes; indeed, the subsistence consumption waves out in the LES demand function when there is only one good. The Engel aggregation requires that the sum of the expenditure share times expenditure elasticity be = 1. If the share =1, the expenditure elasticity must be 1. This ensures that the share of the LES (the beta) is 1, as the beta in the LES demand is given by the expenditure share times

Considering the vulnerability of the economic system described above to external shocks affecting the balance of trade, it is interesting to analyze how the system adjusts to an upward shift of the aggregate import commodity price. . A 20% increase in *PWM* with respect to the base case has been simulated under the different macro-economic and factor markets closures. This simulation may reflect for instance the situation actually faced by most oil-importing less-industrialized countries, which, between 2003 and 2008 had to face a sharp and lasting increase of the international price of oil. The CGE described above has been implemented in GAMS.

All the models are variants of the model reported in table 2. More specifically, the tested closures comprise the neo-classical model, five variants of "Keynesian" closures, a form of the "Johansen" closures and a form of "Kaldor-Pasinetti" closure[154]. A synoptic view of the exogenous and endogenous variables and of equations dropped or included with respect to the general model of table 2 is provided in table 4. A detailed description of the different closures is provided here below. The results of the simulations are reported in table 5.

All the models exhibit a common result: the GDP does not change as a response to the import price shock. This is due to the fact that, one the one hand, for the neo-classical, Johansen and Kaldor-Pasinetti models, changes in GDP occur only if there is a change in factor endowments. On the other hand, in the Keynesian models changes in GDP occur if there are changes in the autonomous components of the effective demand, say consumption of the government *CG* and demand for investment *I*. For other aspects the models provide significantly diversified results.

Neoclassical closure. In the neoclassical model, the equation setting the labour wage (equation D) and the equation allocating unemployment to the two households (equation U) are dropped. The two variables referring to unemployment (*UNEMPp* and *UNEMPn*) are dropped. In addition, by dropping both the equation setting intra-household transfers (equation F1) and fixing the intra-household transfers variables, the intra-household transfers are assumed to be exogenous. The exchange rate *EXR* is endogenous while the foreign savings *FSAV* are fixed to their benchmark value. The labour wage is free to move up to a point where it equates the marginal value product of labour. At that point, the production sector absorbs all the available quantity of labour *QLS*. The investment demand is endogenous.
The shock on *PWM* affects the balance of trade (equation Y). Other things equal, *QM* reduces to restore the trade balance. This is due also to the fact that foreign savings *FSAV* are exogenous (fixed at the benchmark level). The appreciation of the exchange rate contributes

---

expenditure elasticity. The Curnot aggregation requires that the sum of the expenditure share of the good x times its own price elasticity plus the sum of shares of other goods times their cross price elasticities with x be equal to: minus the share of x. This implies that the expenditure share of x be =1. The other shares are 0, therefore: 1 * own price elasticity = -1. this implies that the own price elasticity = -1. Working out the Frisch paramerer compatible with such elasticities leads to conclude that any value for the Frisch parameter is compatible. Indeed, the subsistence consumption waves out in the LES demand function when there is only one good.

[154] The reference to the various authors in naming the different closures does not necessarily imply a full adherence of the adopted model to the theories or visions of the authors themselves, as also discussed in Decaluwé et al. (1987), Decaluwé, B et al. (1987). Macro-closures in an open economy CGE models: A numerical reappraisal. Chaier 8704. C.R.D.E. Université de Montreal. For example, here the denomination "Kaldor-Pasinetti" is associated to a model of full employment not because these authors ruled out unemployment as a significant feature of real socio-economic systems but because we want to highlight the emphasis put on the income distribution changes, in presence of different propensities to save of different social groups, as an important adjustment factor of socio-economic systems hit by "shocks".

to lower the domestic prices of imports, but at the same time depresses the price of exports[155]. Overall, an increase of *PWM*, through equation P reduces *PM*. Through the equation R (Armington) the demand of the transformed good *QDD* used to create the composite final good *QQ* increases. This implies that the exports *QE* decrease. The increase of the cost of the imports generates an increase of the price of the domestic final good *PQ* with respect to the domestic factors. Being *PQ* anchored to the numeraire *CPI* which is fixed to 1.00, this is reflected in an identical reduction of the prices of both capital and labour. The decrease in the price of factors generates a loss of income of both poor and non-poor. However, as the weight of the income from factors is smaller in the in the income of poor than in the income of non poor[156], the income of poor households reduces less than proportionally with respect to the income of non-poor households. This is reflected in the reduction of private savings, reduced consumption expenditure, reduced physical consumption and worsened Equivalent Variation (*EV*) both for poor and non-poor households. The above-mentioned differences in the structure of the income of poor households with respect to the non-poor ones, generates a greater percentage reduction in the equivalent variation of non-poor with respect to poor households. The government consumption *CG* is exogenous and fixed at the benchmark. This fact, associated to a reduction of the tax revenue, due to reduced income taxes and import tariffs, increases the government deficit *GSAV*. In turn, this fact, associated to the loss of private savings due to reduced incomes and the loss of foreign savings in domestic currency due to the appreciation of the exchange rate through the S-I balance (equation Z) reduces the expenditure for investment. This is a peculiarity of the neo-classical closure, where endogenous investments passively adapt to the available savings within the system.

Keynesian closures. The first four "Keynesian" closures differ from the neoclassical one in two fundamental aspects: 1) unemployment is allowed and determined on the basis of an "exogenously set" labour wage[157]. Equations EQUNEMP and EQWAGE, (U and D in table 2) are included, allowing for the inclusion of two additional variables reflecting unemployment in the two households. 2) As in the "typical" Keynesian world, investment is set exogenously, i.e. no longer adapts to savings as in the neoclassical case. The differences among the first three Keynesian closures consist in a different treatment of government consumption, taxation and savings. The third "Keynesian" closure is probably the one which better reflect the "Keynesian" framework, where both investment and government consumption are exogenous and, domestic private savings are the only endogenous component of the Savings-Investment balance. The fourth closure is a replica of the third with a much lower Armington elasticity. The fifth "Keynesian" closure still allows for unemployment but fully endogenizes the labour wage.

Under **"**Keynes 1", one component of the autonomous demand, notably the government consumption, is endogenous, together with the government savings and the foreign savings. As in the neoclassical case, an increase of *PWM* is reflected on *PM*. In addition now, the reduction in the foreign savings, implying a reduced supply of foreign currency, allows limiting the appreciation of the domestic currency, thus generating an even higher *PM* than in the neoclassical case. Unemployment is now allowed. As the labour wage is not allowed to

[155] A lower elasticity of substitution in the Armington CES would have implied a reduced appreciation or even a depreciation of the domestic currency with respect to the foreign one, as signaled for instance in ther simulation "Keynes 4".

[156] Conversely, the weight of the exogenous components (transfers from the government and from other households) is greater for poor than for non-poor households.

[157] In the model, the wage is set on the basis of the wage level in foreign labour markets, as described in section 4.1. Note however that it is not fully endogenous, as it is assumed that workers look at the foreign wage converted in local currency through the prevailing exchange rate, which is endogenous.

adjust with respect to the price of capital and the output as desired, unemployment emerges. The reduced employment and the reduced imports contribute to generate a reduction of the supply of final composite good *QQ*. On the other hand, as the capital factor is not allowed to be unemployed, its price reduces more than the price of labour. However, despite the change in relative prices, factor payments shift in favour of capital, as this remains fully employed[158]. The reduction in the use of labour leads to a reduced domestic output. However, the reduction in the export price in local currency, due to the appreciation of the exchange rate, leads to a reduction of exports and to an increase of the transformed good absorbed by the domestic market. However this increase is not sufficient to compensate the reduction of the import due to the import price increase as the net combined effect of the appreciation of the exchange rate (reducing the import price) and the simulated shock (increasing it). Overall, this leads to a reduction in the supply of the composite final good which is stronger than under the neo-classical scenario.

In the current account balance, the simulated external shock on the import price (+20%), leads to an excess of foreign currency, due to: 1) the very price-elastic imports leading to a reduction of the outflow of foreign currency for imports with respect to the benchmark[159] 2) less than proportional reduction of export inflows with respect to the reduction of export outflows[160]. Foreign savings *FSAV* need therefore to shrink to restore the current account balance equilibrium. However, the reduction of foreign savings leads to a "shortage" of savings in the S-I balance, reinforced by the appreciation of the exchange rate, because the investment demand *QINV* is exogenously fixed (anchored at its benchmark value). As also private savings shrink, due to shrinking factor incomes, government savings have to adjust to fill the gap in the S-I balance. This is done through reduction of the government deficit *GSAV*. The reduction of the government deficit, has to occur despite: 1) shrinking tax revenues due to reduced taxes on imports and reduced taxes on income; 2) reduced value of foreign transfers (foreign aid) in domestic currency, due to the exchange rate appreciation, which constitute a large component of the government budget. The deficit reduction is obtained by a reduction of government consumption *CG* more than proportional than the reduction of fiscal revenues. This leaves room to private consumption and investment demand. Overall however, under "Keynes 1", due to some labour endowments left unemployed, the simulated import price shift hits the welfare (*EV*) of both poor and non poor households more than under the neoclassical closure.

When comparing the neoclassical closure with Keynes 1, it has to be noted that when foreign savings constitute a significant part of the total savings, as in the case of the archetypical economy under consideration, and they are fixed, as under the neoclassical closure, downward shifts in the exchange rate generated by shocks on international prices significantly reflect on the S-I balance, reducing the foreign savings in domestic currency. If this aspect is associated with endogenous investment demand, as in the neoclassical case, the investment demand is forced downward. If the investment is exogenous, as under Keynes 1, the domestic savings are forced upward. In this case, as private savings shrink due to shrinking income, government savings have to increase to adjust the S-I balance. If tax rates are fixed, income is

[158] This can be easily seen by calculating the reduction in the factor payments, i.e. by multiplying the reduction of the wage times the reduction of the factor demand. For labour this amounts to: 0.975*0952=0.928, i.e. a reduction of 7.2%. For capital this amounts to: 0.943*1.00=0.943, i.e. a reduction of 5.7%.

[159] The index of *PWM* times the index of *QM* amounts to 120.0*75/100-100=-10, i.e. -10.0%). As a result, the increase in the price of imports is more than countervailed by the reduction in the import quantities.

[160] This results by multiplying the export price index times the export quantity index: (100.0*95.9/100-100=-4.1, i.e. -4.1%).

shrinking and import taxes shrink as well due to reduced imports, the increase of government savings has to occur through the reduction of the (endogenous) government consumption, as under Keynes 1. If foreign savings were only a marginal component of the S-I balance, as in less unbalanced economies, both the S-I balance and the government balance would be less sensitive to shifts of the exchange rate and shocks on the trade balance would have less impacts on the other macro-balances and in turn of the rest of the economic system.

A similar consideration holds when looking at the impact of an exchange rate shift on the government budget in presence of a large amount of foreign transfers (e.g. foreign aid). Assuming exogenous and fixed foreign transfers, a downward shift of the exchange rate reduces the amount of transfers in domestic currency, reducing, other things equal, the government savings. But, for the considerations on the S-I balance above, savings have to adjust upwards. In practice, the adjustment of the government savings occurs upward or downward according to the relative importance of foreign savings with respect to foreign transfers, while the other endogenous variables affecting the S-I and the government balances bear the burden of the residual adjustments.

Keynes 2 differs from Keynes 1 because here also the government consumption, in addition to the investment demand, is assumed to be exogenous. This is done through the endogenization of the aggregate income tax rate. However, government savings and foreign savings are still endogenous. The main difference here is that the proportional shift of the tax rates alters the expenditure distribution between poor and non poor, to the advantage of the poor, who at the benchmark pay a lower rate. Now, the government demand does not shrink as under "Keynes 1", because it is exogenous (fixed at its benchmark level). This leads to an expansion of the labour demand because the reduction if imports due to their simulated price increase, is compensated by an increase of the demand of domestic transformed good, which in turn generates an expansion of the domestic output. Indeed, "negative unemployment", which can be interpreted as a pressure on the labour market generated on the demand side, satisfied by some form of additional supply of labour[161], allows for a larger availability of the final composite good than under the Keynes 1 scenario. This is however absorbed by the government to the detriment of private consumption, generating worse EV indicators than under "Keynes 1". Foreign savings, which are endogenous, shrink to accommodate the current account balance, as discussed under "Keynes 1". Government savings increase to accommodate the S-I account. Direct adjustments of foreign and government savings do not allow adjustments of the savings through shifts in the income, which, by the way, is upward constrained by factor endowments, capital in this case.

Under "Keynes 3", the supply of capital is endogenized, allowing the system to absorb all the quantity of labour and capital required to satisfy the effective demand. The government savings and the foreign savings are exogenized, so the domestic savings expand (or shrink) to a point where they match the investment demand, which is exogenous. In absence of constraints on the endowments, The S-I balance acts as the constraint to the expansion of the system[162].

[161] "negative unemployment" in this context has to be intended as additional labour requirements that would occur if the simulated price shock occurs and the model correctly interprets the economic system. As for simplicity we have assumed that at the benchmark there is no unemployment, this additional labour supply could come for instance from immigrants or from extra-hours worked, or the emersion of hidden unemployment (increased participation rate) etc.

[162] Under "Keynes 3", analogously to Keynes 2, negative unemployment is generated, because unemployment is set at zero at the benchmark. This has to be read as an expansion of the labour demand. If unemployment was set at a positive value this would have amounted to a reduction of unemployment.

A release of this constraint, through for example an exogenous increase of investment, on the one hand, requires and expansion of the domestic savings. On the other hand, the demand for investment activates the production process which requires more factors. Factor income expands, and both consumption and savings expand, with consumption demand giving rise to additional production. Overall, through the multiplier effect, production increases up to a point where the effective demand is satisfied and savings equate investment.

The "Keynes 4" scenario replicates the "Keynes 3", the only variant being a reduction of the Armington elasticity in absolute value from 1.75 to 0.75. This implies that a 1% decrease of the ratio *PD/PM* decreases the ratio *QM/QD* of 0.75 instead of 1.75, i.e. the system is less prone to substitute imports with domestic goods. Under this scenario the expansion of the final composite good is more limited than in the case of greater substitutability and factor demand shifts from labour towards capital.
The fifth Keynesian closure drops the wage constraint and endogenizes *GSAV* while maintaining the aggregate income tax rate endogenous. Under this scenario, the final composite good drops dramatically, government savings significantly increase thanks to increases of tax rates, to compensate the decrease of private savings due to the fall of household income.

"Johansen" closure. Under this closure, both capital and labour endowments are fully employed. Both government consumption and government savings and the aggregate income tax rate are endogenous, while investment demand, and foreign savings are exogenous. The endogeneity of the variables related to government plays a central role in bringing the system back to equilibrium after a shock. Comparing the "Johansen" with the neo-classical closure allows highlighting the role of the government in compensating the reduction of private savings and foreign savings. As investment is exogenous, also total savings are exogenously set as they have to comply with the S-I balance. Two facts emerge with respect to the neoclassical closure: 1) the gap in the S-I balance left by the downward shifts of the private savings and foreign savings in domestic currency, generated by the appreciation of *EXR* in presence of fixed *FSAV* in foreign currency, is compensated by an upward shift of government savings (indeed, a reduction of its deficit); 2) The purchasing power shifts from private households to the government (see the reduction in household expenditure w.r.t. the neoclassical case) thanks to an increase of the income tax rates of more than 40%. As non-poor exhibit at the benchmark a greater tax rate, this implies a reinforcement of the progressive tax scheme, to the advantage of the poor households (compare the consumption and EV indexes). This upward shift in government savings is generated by a simultaneous increase of tax revenues and a reduction of government expenditure.

"Kaldor-Pasinetti". This closure emphasises how income distribution changes, in presence of different propensities to save of different social groups, play an important role in the adjustment of the socio-economic systems hit by an external shock. Under this closure, the intra-household transfers (*INTRAh*) are endogenized. An equation setting the sum of intra-household transfers to zero is added to the model. Investment demand is exogenous and set to the benchmark. The external shock on import prices generates a loss of income, generating in turn a loss of private savings. The S-I balance is restored through a transfer of income (indeed a reduction in transfers from non-poor to poor with respect to the benchmark) from poor households, who exhibit a lower propensity to save (12.6%) to non-poor households, who have a higher propensity (16.8%), thus restoring the S-I equilibrium. The shift of purchasing power is apparent when looking at the larger gap between the expenditure (and EV) of poor

and non-poor households than the gap between their incomes. Under this closure both income taxes and intra-household transfers play this role. Here, negative taxes (subsidies) with higher rates for the non-poor play in favour of them, against the poor. A variant of this closure (not reported in table 5) implies leaving the burden only to shifts of the tax rates adjustment. Of course, the transfer of income has welfare implications as the welfare of poor households is negatively hit, while the one of non poor is boosted.

Table 4. Endogenous and exogenous variables relevant for setting alternative macro and factor market closures

Var. Code	Description	#	General	Neoclass.	Keynes 1	Keynes 2	Keynes 3	Keynes 4	Keynes 5	Johansen	Kaldor-P.
	Variables										
QKSh	Supply of capital by household	2	X	X	X	X	ENDO	ENDO	X	X	X
QLSh	Supply of labour by household	2	X	X	X	X	X	X	X	X	X
TRGh	Transfers from govt to hous.	2	X	X	X	X	X	X	X	X	X
GSAV	Government savings (deficit)	1	X	ENDO	ENDO	ENDO	X	X	ENDO	ENDO	X
FSAV	Foreign savings	1	ENDO	X	ENDO	ENDO	X	X	X	X	X
FTANSF	Foreign Aid to government	1	X	X	X	X	X	X	X	X	X
REMFCh	Remittances by household	2	X	X	X	X	X	X	X	X	X
CG	Government consumption	1	ENDO	ENDO	ENDO	X	X	X	X	ENDO	ENDO
UNEMPh	Unemployment by household	2	ENDO	X	ENDO	ENDO	ENDO	ENDO	ENDO	X	X
QINV	Investment demand	1	ENDO	ENDO	X	X	X	X	X	X	X
TY	Aggregate income tax rates	1	X	X	X	ENDO	ENDO	ENDO	ENDO	ENDO	ENDO
INTRAh	Intra-households transfers	2	ENDO	X	X	X	X	X	X	X	ENDO
	Equations										
EQWAGE	Wage equation	1	INCL	DROP	INCL	INCL	INCL	INCL	DROP	DROP	DROP
EQUNEMPh	Equation to allocate unemp.by hous.	1	INCL	DROP	INCL	INCL	INCL	INCL	INCL	DROP	DROP
EQINTRAh	Equat.setting sum of intrah.transf.=0	1	INCL	DROP	DROP	DROP	DROP	DROP	DROP	DROP	INCL

* In its general form, the model presents one endogenous variable more than the number of independent equations. One variable needs to be exogenously determined (fixed") to "square" the model and to make it solvable. In addition, for each equation dropped an additional variable needs to be "fixed".

Table 5. General equilibrium model results under alternative macro and factor market closures for the archetypical economy

V.#	V.Code	Variable Name	Base	Neo-class.	Keynes 1	Keynes 2	keynes 3	keynes 4	keynes 5	Johansen	Kaldor-P.
1	*GDP*	GDP at market prices	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2	EXR	Exchange rate	100.0	92.6	95.9	94.7	94.2	101.8	93.7	92.6	92.6
3	WK	Price of Capital services	100.0	96.4	95.7	96.8	97.3	90.0	99.1	96.4	96.4
4	WL	Labour wage	100.0	96.4	95.9	94.7	94.2	101.8	91.5	96.4	96.4
5	PQ	Final composite good price	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
6	PX	Price of domestic commodity	100.0	97.9	97.5	97.6	97.7	96.5	97.7	97.9	97.9
7	PDD	Price of transformed good	100.0	98.1	97.6	97.8	97.9	96.2	98.0	98.1	98.1
8	PE	Price of exports	100.0	92.6	95.9	94.7	94.2	101.8	93.7	92.6	92.6
9	PM	Price of imports	100.0	120.4	124.6	123.1	122.4	132.4	121.8	120.4	120.4
10	Yp	Income of poor	100.0	96.7	96.3	97.6	104.1	104.7	100.6	96.7	87.4
11	Yn	Income of non poor	100.0	96.3	95.7	97.1	102.0	98.2	100.4	96.3	98.4
12	*S*	Total savings	100.0	86.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0
13	Sp	Savings of poor	100.0	96.7	96.3	95.8	103.9	104.9	100.0	96.0	89.7
14	Sn	Savings of non poor	100.0	96.3	95.7	92.7	101.5	98.5	99.0	94.7	104.5
15	EXPp	Expenditure of poor	100.0	96.7	96.3	95.8	103.9	104.9	100.0	96.0	89.7
16	EXPn	Expenditure of non poor	100.0	96.3	95.7	92.7	101.5	98.5	99.0	94.7	104.5
17	*TREV*	Total tax revenue	100.0	95.1	94.0	126.4	104.6	98.5	108.9	106.5	52.3
18	*ty*	Aggregate income tax rate	100.0	100.0	100.0	211.5	112.9	92.6	134.5	141.4	- 55.0
19	GOVREV	Government budget revenue	100.0	94.0	94.8	112.4	100.0	100.0	102.2	100.4	70.1
20	GOVEXP	Government budget expenditure	100.0	100.0	83.5	100.0	100.0	100.0	100.0	95.7	75.6
21	GSAV	Government savings (deficit)	- 100.0	- 126.6	- 32.8	- 44.7	- 100.0	- 100.0	- 90.3	- 74.9	- 100.0
22	*TRG*	Transfers from govt to households	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
23	FSAV	Foreign savings	100.0	100.0	52.3	73.5	100.0	100.0	100.0	100.0	100.0
24	*QKS*	Supply of capital	100.0	100.0	100.0	100.0	105.0	112.9	100.0	100.0	100.0
25	*QLS*	Supply of labour	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
26	*QQ*	Quantity final composite good	100.0	97.3	95.9	97.6	103.3	101.8	101.3	97.3	97.3
27	QX	Quantity of domestic commodity	100.0	100.0	99.9	101.2	107.0	105.4	104.7	100.0	100.0
28	QDD	Quantity of transformed good	100.0	100.5	100.1	101.5	107.3	104.8	105.1	100.5	100.5
29	QK	Demand of capital	100.0	100.0	100.0	100.0	105.0	112.9	100.0	100.0	100.0
30	QL	Demand of labour	100.0	100.0	99.7	103.3	110.2	93.7	112.7	100.0	100.0
31	QQp	Private consumption poor	100.0	96.7	96.3	95.8	103.9	104.9	100.0	96.0	89.7
32	QQn	Private consumption non poor	100.0	96.3	95.7	92.7	101.5	98.5	99.0	94.7	104.5
33	QINV	Investment demand	100.0	86.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0
34	QE	Export quantity	100.0	90.8	97.0	96.0	100.3	115.7	97.2	90.8	90.8
35	QM	Import Quantity	100.0	80.8	75.0	78.1	83.4	87.6	82.6	80.8	80.8
36	CG	Government physical consumption	100.0	100.0	81.5	100.0	100.0	100.0	100.0	95.2	72.7
37	*Evp*	Equivalent Variation poor	100.0	96.7	96.3	95.8	103.9	104.9	100.0	96.0	89.7
38	*Evn*	Equivalent variation non poor	100.0	96.3	95.7	92.7	101.5	98.5	99.0	94.7	104.5
39	*INTRAn-p*	Transfers from non-poor to poor	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	16.1
40	*UNEMPL*	Unemployment (% of total L.Supply)	0.00%	0.00%	0.25%	-3.07%	-9.41%	5.76%	-11.74%	0.00%	0.00%

* Variables whose name is reported in italics refer either to: exogenous or "post-solve" calculated variables or totals of endogenous variables.

5. Some policy implications

Under the neo-classical closure with fixed foreign savings, in presence of significant amount of foreign savings, (i.e. deficit of the current account) as in the case of this archetypical economy, the appreciation of the exchange rate negatively affects the demand for investment through the variation of the value of foreign savings in domestic currency in the S-I balance. This contributes to leave more final output for private consumption, implying "better" household welfare indicators. While this result may lead to "optimism" in the short term, it hides longer term consequences for development perspectives. Less investment lead to less capital accumulation thus less production potential in the future.

The Assumption that external shocks on international prices, associated to institutional rigidities on factors, may generate unemployment (the "Keynesian" closures), allows us providing a more realistic picture than assuming that factor markets will be able to absorb all shocks. However, the impact of an increase of import prices crucially depends on the way the economic system is able to substitute for imports with domestic products. Low capacities of substituting for imports are reflected in the model by a low elasticity of substitution (Armington elasticity). Low elasticities of substitution apply to all those commodities which cannot be produced domestically while are essential for the functioning on the economic system. In these cases, imported goods have limited or no substitutes, such as energy products in non-oil endowed countries or agricultural chemicals in non-producing countries.

Low substitutability of imports in cases of external shocks on import prices badly reflects on welfare of households, investment possibilities and capacities of government interventions to redistribute income and provide good and services[163]. In particular different assumptions on the elasticities of substitution between imported and domestic goods alter the impacts not only on the general level of welfare, but also its distribution. If we refer to an economy where factors are unemployed, (such as the one analyzed under the "Keynes 3" and "Keynes 4" scenarios in the previous section), different assumptions regarding the Armington elasticity imply also a different intensity in the use of factors. A lower elasticity of substitution, associated to wage rigidity in the labour market, is likely to leave more labour unemployed than in presence of a higher elasticity of substitution. This is also likely to shift factor payments toward capital.

The actual possibilities for a system to expand are linked to the existence of factors which can be mobilized. Hidden unemployment, in the form of underemployed family labour for instance, or even unconventional forms of capital, both man-made, natural and intellectual, such as biodiversity, specific climatic conditions, indigenous knowledge etc. may be put at work through appropriate policies. For the archetype economy described above, this in particular applies to sectors which can effectively provide import substitution. This is for instance the case of the energy sector which drains a large portion foreign currency of non-oil endowed countries, where actual

[163] This consideration is applies across all the closures tested. This conclusion is based also to simulation scenarios calculated by the author but not reported in table 5 for space reasons.

substitution possibilities, such as bio-masses, solar technologies wind or water could help relaxing the current account constraint. However, models can provide responses on shifts in factor demands under a given policy scenario only to the extent to which these factors actually enter production functions. Unfortunately, some essential assets, such as environmental assets, or even appropriate institutions ensuring the correct functioning of markets, are difficult to quantify, thus often excluded by CGEs built for operational purposes. Therefore, constraints actually faced by real economic systems in absence of those assets are not reflected in models' results. This implies that scenarios potentially doable according to model results, may prove to be undoable in practice, due to the missed inclusion of required production factors in the model.

In all scenarios implying unemployment, an issue, not directly tackled by this CGE model is the income distribution between employed and unemployed. In situations where substantial increases of welfare of selected layers of the population are associated to significant increases of unemployment (such as the scenario described under "Keynes 4"), if poverty, an even, food security issues have to be avoided, redistribution mechanisms to ensure income support to unemployed need to be assured. Ensuring the direct public provision of services to the weaker layers of the population, in addition to ensuring equity, sustains the effective demand, generating multiplier effects which expand the output, and the income of the economy. On the other hand, situations where fiscal instruments, such as relatively high levels of income taxation (as in the Johansen 1 and 2 scenarios) drain to heavily on incomes of private agents resources that the welfare of people can be significantly negatively affected if fiscal resources are not used to sustain internal demand but used e.g. to fund too drastic international loan pay-back plans.

6. Conclusions

In this paper, we analyzed the way different external shocks or policy measures affect an economic system, with the aim of identifying analytical implications relevant for policy making. Even economic policies, aimed at affecting specific segments of the economic system may have significant spill-overs and macro-economic impacts through the channels mutually linking production activities, factor markets, households, the government and the "rest of the world". For this reason CGE models are widespread tools to simulate ex-ante the possible impacts of various policy options. However, the results of the simulations have to be interpreted in the light of the macro-economic and factor-related assumptions undertaken. An A detailed discussion of selected alternative macro-economic and factor market closure was carried out. However, the results of the alternative closure rules depend also on the structure of the economic system. For socio-economic development policy making it is important to better understand the extent to which the different closures affect the results of CGE models when they are applied to less industrialized countries. The SAM of a paradigmatic aid-dependent oil-importing less industrialized country has been chosen to calibrate a simple one sector-two-factor two household CGE model. Some tests with alternative closure rules have been carried out simulating the impacts of an international import price shock. Peculiar differences in the results emerged when contrasting "Keynesian" types of models, allowing for unemployment of factors with full employment models. Negative impacts of import price rises can turn out to be positive if it is assumed that factor endowments are not completely exploited and

large or even relatively large elasticities of substitution between imports and domestic goods are chosen. In addition, given the importance of the foreign savings (the deficit of the current account) and foreign transfers (foreign aid) for this type of economy, the exchange rate plays a crucial role as it directly affects important components of both the Saving-Investment balance and the government balance. Alternative macro- and factor market closures have to be tested, as well as sensitivity analyses on elasticities whose actual level may be difficult to estimate, have to be carried out if proper use of general equilibrium models has to be made for actual decision making.

7. References

Armington, P, (1969): A Theory of Demand for Products Distinguished by Place of Production. International Monetary Fund Staff Papers, XVI (1969), 159-178.

Arrow, K and Debreu, G. (1954): *Existence of a Competitive Equilibrium for a Competitive Economy*. Econometrica **22** (3): 265-290

Bellù L.G., Pansini R.V. (2009): Quantitative Socio-Economic Policy Impact Analysis: A Methodological Introduction. EASYPol series n.235. www.fao.org/easypol Food and Agriculture Organization of U.N -Rome.

Chenery, H.B. and Uzawa H. (1958): Non-linear Programming in Economic development. In Arrow,K. Hurwicz, L. an Uzawa H. (eds) Studies in linear and on-linear programming, Palo Alto CA. Stanford University press.

Deardorf A.V. and Stern R.M. (1986): The Michigan model of world production and trade: theory and applications. Cambridge. MIT press.

Debreu, G. (1959): Theory of value: an axiomatic analysis of economic equilibrium. New York, Wiley

Decaluwé, B. et al. (1987): Macro-closures in an open economy CGE models: A numerical reappraisal. Chaier 8704. C.R.D.E. Université de Montreal

De Melo, J. Robinson S. (1989): Product differentiation and the treatment of foreign trade in computable general equilibrium models of small economies Journal of International Economics, Volume 27, Issues 1-2, August 1989, Pages 47-67

Dixon, P.B, Parmenter, B.R., Sutton, J. and Vincent ,D.P. (1982): ORANI: a multisectoral model of Australian economy. North Holland, Amsterdam.

Harberger, A, (1962) The incidence of corporate income tax. Journal of political economy. 70: 215-240

INSD, (2003): Profile de Burkina Faso la Pauvreté en 2003. Ministère de l'Economie et du développement. Segretariat General, Insitut National de la Statistique et de la Démographie (INSD).

Johansen, Leif (1960): "A multi-sectoral Study of economic growth". Amsterdam, North-Holland (2nd enlarged edition, 1974).

Kaldor N. (1955): "Alternative theories of distribution". The review of economic studies, pp 83-100.

Keynes J.M.(1936): The general theory of employment, interest and money. Electronic version, at http://homepage.newschool.edu/het//texts/keynes/gtcont.htm.

Merril, O.H. (1972): Applications and extension of an algorithm that computes fixed points of certain upper semi-continuous point to set mapping. Department of Industrial Engineering, University of Michigan.

Missaglia M. (2011): Neoclassical and Keynesian macro-models: Thinking about the special case. University of Pavia,(It). MIMEO

Pasinetti L.(1962): Rate of profits and income distribution in relation to the rate of economic growth. The review of economic studies, vol. XXXIX n.4, Oct 1962 pp.267-279.

Pasinetti L.(1974): The economic theory of effective demand, in: Growth and income distribution. Essays in economic theory. Cambridge, Cambridge University Press, 1974, pp. 60-63 and the appendix on the "delayed multiplier".

Round J. (2003): Social Accounting Matrices and SAM-based multiplier analysis", chapter 14 in F. Bourguignon and L.A Pereira da Silva (Eds): The impact of

economic policies on poverty and income distribution, New York, World Bank and Oxford University Press.

Rattso, J (1982): "different Macroclosures of the Original Johansen Model and Their Impact on Policy Evaluation". Journal of Policy Modelling 4(1) p.85-97.

Robinson S. (1989): Multisectoral models, (chapter 18) in Handbook of development economics, Elsevier.

Scarf, H.E. (1960): Some examples of global instability of the competitive equilibrium. International economic review, 1, 157-172.

Scarf, H.E. (1967): The approximation of fixed points of a continuous mapping. SIAM. Journal of applied mathematics. 15, 1328-43.

Sen A (1963): "Neo-classical and neo-Keynesian theories of distribution" Economic Record, March 1963, pp 53-64.

Showen, J.B. and Whalley J. (1972): A general equilibrium calculation of the effects of differential taxation on income from capital. Journal of public economics 1, 281-322.

Showen, J.B. and Whalley J. (1974): A proof of the existence o a general equilibrium with ad valorem commodity taxes. Journal of economic theory 8, 1-25.

Showen, B.J., Walley, J. (1992): Applying general equilibrium. Cambridge surveys of economic literature, Cambridge University Press.

Taylor L. And Lysy F.J (1979): Vanishing Income redistributions: Keynesian clues about model surprises in the short run. Journal of development economics, 6, (1979) 11-29, North Holland.

Taylor L. (1990): Structuralist CGE models, in Taylor L. (ed) ; Socially relevant Policy Analysis: Structural comptable general equilibrium models for developing world . Cambridge (MA): MIT press pp. 1-70.

Taylor L, Arnim von R. (2006): Modeling the impact of trade liberalization. A critique of computable general equilibrium models. P.21. Oxfam research report July 2006.

Thissen M. (1998): A classification of empirical CGE modelling, p.9. SOM Research Report 99C01, University of Groningen, The Netherlands.

United Nations, Statistical Division (1993): System of National Accounts. http://unstats.un.org/unsd/sna1993/toctop.asp

Van der Laan, and G., Talman, A. J (1979): A restart algorithm for computing fixed point without an extra-dimension. Mathematical programming 17, 74-84.

Walras, L. (1874): Éléments d'économie politique pure, ou théorie de la richesse sociale (Elements of pure economics, or theory of social wealth.) Lausanne, L. Borbax ed.

Willenbockel D. (1994): Applied general equilibrium modelling: Imperfect competition and European integration. Wiley.

Winters, P., De Janvry A., Sadoulet E., Stamoulis K, (1996): The Role Of Agriculture In Economic Development: Visible And Invisible Surplus Transfers Department of resource economics working paper n 143.

International price shocks and development: A general equilibrium approach with applications to Burkina Faso.

Part 3:

International price shocks in Burkina Faso: assessing development impacts with a Computable General Equilibrium (CGE) approach.

Tesi di Dottorato di Lorenzo Giovanni Bellù
Matricola: 3580130
Anno accademico 2009-2010

Abstract

After sketching the links between development and agriculture, this paper analyses the implications on welfare and growth of recent international price shocks, notably energy and agricultural products, in Burkina Faso, a less industrialised, low-income, food-deficit, net oil-importing country. The socio-economic impacts of the above-mentioned external shocks are analysed by means of a Computable General Equilibrium model (CGE). The results of the analysis show that oil price hikes in recent years had much greater impacts on the welfare of the poorer layers of the population than any other price shifts. The paper discusses also the extent to which technological changes in agriculture, specifically the introduction of "Good Agricultural Practices" (GAP) towards "conservation agriculture", could mitigate the welfare and growth losses derived by international price shocks. It is shown that the technological changes explored in this paper, in spite of their significant impacts on agricultural productivity, by no means countervail the negative welfare and growth losses brought by international price shocks. The energy dependency, particularly in a context of high oil prices, looks as a channel that systematically siphons out domestic resources, jeopardizing household welfare and seriously hampering domestic primary capital accumulation and related endogenous-growth potential. Policy implications for poverty reduction and food security are that suitable policies should favour not only the adoption of appropriate energy-saving agricultural technologies but also the exploitation of sustainable energy production potential of rural areas. These findings are likely to apply to other less-industrialised energy-importing countries with similar socio-economic structure. Furthermore, by providing and comparing alternative analytical frameworks, notably related to macro-economic model closures and assumptions on factor markets, this paper emphasizes the importance of reading model results in the light of the assumptions made and carrying out appropriate sensitivity tests on most relevant hypotheses.

Table of contents

1 Introduction....4
2 Development and agriculture in open economies....4
3 International price shocks and development: the case of Burkina Faso....9
4 The structure of the national economy....13
5 The CGE of Burkina Faso....20
5.1 Data sources....20
5.2 Macro-economic closures....22
5.3 Closures for factor markets....28
6 Simulations of socio-economic impacts of external shocks....31
6.1 Macro economic impacts....31
6.2 Activity levels....35
6.3 Welfare impacts....37
6.4 Alternative macro-economic and factor-market closures....41
6.5 Simulations under alternative macro-economic and factor-market closures....44
6.6 Implications of alternative macro and factor market closures....66
7 Technological Changes under "Good Agricultural Practices"....67
8 Some policy implications....73
9 Conclusions....75
10 References....77
11 Appendix A: Detailed data and tables....80
12 Appendix B: features of the CGE model adopted....84
12.1 The LES demand system....84
12.2 Armington functions for imported goods....91
12.3 CET functions for Export versus Domestic Supply....95

1. Introduction

This paper, aims at analyzing the implications on welfare and growth of recent international price shocks, notably energy and agricultural products, in Burkina Faso, a less industrialised, low-income, food-deficit, net oil-importing country. The socio-economic impacts of the above-mentioned external shocks are analysed by means of a Computable General Equilibrium model (CGE).

The structure of the paper is as follows: in section 3, the links between agriculture and development are highlighted. The analysis of some international price shocks applied to Burkina Faso is carried out in sections 4 to 8. The main socio-economic features of the country are then illustrated in sections 4 and 5. Here, the country's economic structure is analysed using selected macro-economic data, including a Social Accounting Matrix (SAM). A SAM-based Computable General Equilibrium model of the country is presented in section 6. To test the extent to which international price changes affect the socio-economic system, some CGE simulations for different commodities, notably oil, fertilisers, food and cotton, have been carried out and presented in section 7.. In section 8, the socio-economic impacts of introducing technological changes in the agricultural sector are analysed by means of some additional CGE-based simulations. Possible policy implications are discussed in section 9 and concluding remarks are also provided. The paper is complemented by two chapters in appendix. The first one comprises detailed data tables and results of the CGE models. The second one reports the main equations of the model and some technical considerations on its structure.

2. Development and agriculture in open economies

To achieve the first Millennium Development Goal (MDG) *"Eradicate extreme poverty and hunger"*[164], many less-industrialised countries have relied so far on the formulation and implementation of the so-called "Poverty Reduction Strategies" (PRS)[165]. After the first wave of PRS, in the early 2000s, the focus shifted towards a more balanced, inclusive economic and social development, based on a medium-long term vision of the countries' potential[166]. In this context, the prevailing development paradigm adopted for less-industrialised countries by many bi-lateral and multi-lateral development agencies, including FAO and international banks; focused on the agricultural sector as an engine of growth and poverty reduction[167]. Agricultural

[164] See the site of the United Nations Development Group, in charge of coordinating the work of the various UN development agencies towards the achievement of the Millennium Development Goals (MDGs): *http://www.undg.org.*

[165] The Term "Poverty Reduction Strategy Paper" (PRSP), later on generalised as "Poverty Reduction Strategy", first adopted by the World Bank in 1999, refers to a document "*describing a country's macroeconomic, structural and social policies and programs to promote growth and reduce poverty, as well as associated external financing needs*". Countries are required to prepare and update PRSPs because "*PRSPs are a requirement for countries in order to receive concessional assistance from the World Bank*" (http://go.worldbank.org/ZLBKFM2V90).

[166] World Bank (2005): 2005 Review of the PRS Approach: Balancing Accountabilities and Scaling Up Results. World Bank, Washington D.C.

[167] Indeed, the FAO (FAO, 2003) adopted the so-called *"Twin-Track Approach"*, as the conceptual framework for its "Anti-Hunger Programme". It comprises both programmes aimed at improving the direct and immediate access of food to food-insecure people and interventions aimed at agricultural

development is considered particularly relevant for countries with a large share of agricultural employment in rural areas and the emphasis is put on: 1) direct impacts on farmers' income, especially poor smallholders, 2) indirect impacts via downstream linkages and multiplier effects: distributed income, increased consumption of local goods, etc and 3) its presumed role in slowing down urbanisation and the international migration phenomenon. These arguments are based on findings of a conspicuous mass of studies on agricultural growth and development, carried out in the last sixty years[168].

However, just after the Second World War, the wisdom of 'agriculture' (broadly intended as a set of traditional, subsistence and rural activities) as an ancillary sector functional to the development of the more 'modern' industrial sector, started consolidating. For instance, the Nobel Prize winner Arthur Lewis, in the fifties pioneered the exploration of the industrialisation process of a dualistic economic system, characterised by two sectors: *"subsistence"* sector and *"capitalistic"* sector, with *"unlimited*" supply of labour, flowing from the first to the second. The existence of this "reserve army", concentrated in rural areas (generically referred to as "agriculture" by many authors) kept inspiring in the sixties the traditional view of the link between agriculture and growth, according to which a "developing" economy is a "dual" system where a "dynamic" industrial sector is associated with a more "traditional" agricultural sector. However, very often, the "traditional sector" was not seen only as a "reservoir" of labour, but more generally as a source of "surpluses" (variously defined as for example, savings, excess labour force, inputs, food etc), to be extracted and put at the service of the "modern" (industrial, urban) sector. Fei and Ranis (1964) [169] proposed a dual-economy model where technological changes in agriculture improve the marginal productivity of labour so that it becomes positive but less than the real wage. In this case labour flows to the industrial sector with some loss of agricultural output.Jorgenson (1967) [170], adopting an analytical framework similar to that of Fei and Ranis, added emphasis to the role of the agricultural surplus as a generator of savings, which in turn allowed capital accumulation and consequent expansion of the economic system.

'New dignity' to the 'agricultural' sector, was provided by Dixit (1970)[171], who perceived the agricultural sector not any more as completely ancillary to the rest of the economic system, rather as a sector whose development, by means of technical progress and capital accumulation, can contribute to productive job creation and overall well-being. 'New dignity' to the agricultural sector, intended as 'rural space',

---

development and off-farm income generation, on the assumption that there are mutually reinforcing relationships between these components towards food insecurity and poverty reduction. FAO (2003): Anti-Hunger Programme: A twin-track approach to hunger reduction: priorities for national and international action Food and Agriculture Organization of the United Nations. Rome.

[168] For a comprehensive treatment of the theory of the growth of the agricultural sector within the context of a growing economy see e.g. : Mundlak**,** Y. (2000). *Agriculture and Economic Growth* Theory and Measurement. Harvard University Press

[169] Fei, J. C. H., and Ranis, G. (1964), *Development of the Labour Surplus Economy,* Homewood: Irwin, 1964

[170] Jorgenson D., W. (1967) Surplus Agricultural Labour and the Development of a Dual Economy, *Oxford Economic Papers.*1967; 19: 288-312

[171] Dixit, A., (1970) 'Growth patterns in a dual economy ', *Oxford Economic Papers,* 22 (2) July 1970, pp. 229-33.

was also provided by the work of Harris and Todaro (1970)[172]. In a different conceptual context, characterised by unemployment in the 'modern' sector, they developed a dualistic labour market model on the basis of which some paradigms of the relationships between the agricultural and the industrial sectors needed to be revisited. Productivity improvements in the agricultural sector (considered there as the rural space) were no longer seen as devices allowing the release of labour from agriculture towards the industrial sector, but rather as devices to keep labour in rural areas, thus reducing unemployment in industrial (urban) ones. Therefore, a direct policy implication is that promoting the development of activities in rural areas could reduce the wage differentials between rural and urban areas and, by way of consequence, unemployment in the industrial (urban) sector.

More recently, in the line traced by Johnston and Mellor (1961) [173], Anriquez and Stamoulis (2007) revisited the role of agriculture as an engine of growth providing new evidence to the importance of "backward" and "forward" linkages of the sector. They calculate for a sample of 26 low-middle income countries, backward and forward linkage indexes[174] and emphasise that, in earlier stages of development, agriculture plays an important developmental role thanks to its backward linkages. This opposes the historical wisdom (see e.g. Hirschman, 1958) [175] that denied agricultural development the role of 'engine of growth' due to its weak backward linkages with the rest of the economy.

In addition to the role of agricultural development as an engine of growth, countless authors put a lot of emphasis on its role for poverty reduction and food security ("balanced growth"). The conventional vision on the role of agriculture for poverty reduction is well summarised by Byerlee et al. (2005): "*mass of evidence [is] already available on the central role of increasing agricultural productivity on pro-poor growth, especially in the early stages of development, and especially if productivity growth is transmitted to lower food prices. ... Given widespread household food insecurity, the major challenge in Africa is how to stimulate broad-based productivity growth in food staples and sustain overall productivity gains over decades, if the Asian record of poverty reduction is to be repeated"*.

Also FAO (2009) highlight how poverty is positively affected by agricultural development, specifically by productivity shifts due to investment in infrastructure

[172] Harris, J. R., and Todaro, (1970) M . P., 'Migration, Unemployment and Development: a two-sector analysis', *The American Economic Review,* 60 (1) , Mar. 1970, pp. 126-42.

[173] Johnston B,F and Mellor J,W. (1961): The role of agriculture in economic development, American Economic Review 51(4): 566-593, 1961. Anríquez, G., Stamoulis, K. 2007. Rural development and poverty reduction: Is Agriculture Still a Key? e-JADE, FAO- Rome.

[174] In an Input-Output (I-O) context, as in the one adopted by the authors, "*backward linkages*" are the relationships of a sector with the other sectors via its input requirements; "*forward linkages*" instead refer to relationships of a sector with the others by means of the absorption of the sector's outputs downstream. The authors work out backward and forward linkages of the agricultural sector as first-round multipliers, i.e. "attenuated" Leontief multipliers which rule out second to nth-round effects, on the assumption that these further effects may not be realised due to frictions in the economic system or structural changes occurring during the adjustment process. In addition, these effects are weighted with the relative importance within the economy of the sectors providing the input or adsorbing the output. For more details on these indicators, see Anriquez et al (2003): Anriquez G, Foster, W, Valdéz A (2003): Agricultural Growth linkages and the Sector's Role as Buffer. Roles of Agriculture Project. FAO. Rome

[175] Hirschman, A., O. (1958): The strategy of Economic Development, Yale University Press, New Haven, Connecticut.

and R&D; leading to the consequent reduction in prices of staple food consumed by the poor[176]. The various initiatives adopted in 2008 and 2011 by many international organisations to address the so-called "soaring food prices" crisis, readdressed the focus on the agricultural sector as a "supplier" of food, on the assumption that increased agricultural output and productivity favour poor consumers due to a reduction in food prices (FAO, 2011)[177].

For all the reasons highlighted above, recent agricultural policies for poverty reduction in many less-industrialised countries have as their aims: crop intensification, mechanisation of production processes, increased transformation processes and increased demand of transport services for distribution. This is also the case for Burkina Faso, a semi-arid land-locked country with no fossil energy resources. With a poverty incidence ranging between 40 and 45% of the population, this country faces enormous difficulties in achieving the MDG 1.

Many proposed policy measures for poverty reduction in Burkina Faso within the context of the "Strategic Framework for Poverty Fighting" for 2006-2008, and the "Strategy for accelerated growth and sustainable development 2011-2015"[178] fall into the above-mentioned set of policies, aimed at inducing increased output and productivity.

The achievement of the first MDG however, lies in its reconciliation with other potentially conflicting objectives included in the MDG package; for example, the attainment of local and global sustainability (goal 7). In Burkina Faso for instance, intensification of imported inputs, notably pesticides used in agriculture, as well as the increasing number of dams located in the same river basins, are currently generating environmental externalities that reflect negatively on other productive sectors such as the fishing industry and presumably, health conditions[179]. In addition, substantial financial constraints associated with objective water scarcity are going to be the most limiting factors in the expansion of irrigated land and related yields' increase.

However, beyond the issues related to potential or actual conflicting development objectives, there is a fundamental problem faced by the panoply of agents involved in policy making for socio-economic development. It consists in the missed recognition of mechanisms that systematically siphon resources out of socio-economic systems, hampering the primary accumulation of capital, which is the basis of any development process. Many of these mechanisms in less industrialised countries are influenced, if not determined, by external factors, by means of direct or indirect control on domestic resources and/or by market-price mechanisms. Among them, the energy dependence in net oil-importing countries is particularly important. In recent years in these countries, the energy sector increasingly acted as a "drain of resources" due to dramatic increases in oil prices, as pointed out by Bellù (2007)[180]. Given its

[176] FAO (2009): State Of Food and Insecurity (SOFI) 2009. FAO Rome.
[177] FAO (2011): FAO initiative on soaring food prices: Guide for policy and programmatic actions at country level to address high food prices, FAO UN Rome.
[178] MEF (2011) Stratégie pour la croissance accélérée et le développement durable 2011-2015 (Unpublished). Ministère de l'Economie et des Finances, Burkina Faso.
[179] MECV (2008). Rapport sur la filière Pêche. Ministère de l'Environnement et du Cadre de Vie. Ouagadougou Burkina Faso.
[180] Bellù L.G. (2007). Windfall Oil Profits and Soaring Oil Bills: Some policy implications for Sustainable Development. EASYPol series. FAO UN. Rome

magnitude, this external shock is expected to have huge implications in terms of growth, income distribution, poverty reduction and food security. Unless these macro problems are fixed, most interventions for poverty reduction and development, including initiatives and actions of the international cooperation community, are more than likely destined to miss their objectives.

The vulnerability of "small" countries is accentuated when they are "low" or "lower-middle" income countries[181]. For example the World Bank (2004)[182] states that: "*Low-income countries are particularly vulnerable to natural disasters, terms-of – trade shocks and other adverse shocks*". Among these countries, "Low-Income Food Deficit Countries" (LIFDC), as classified by FAO UN[183] look even more vulnerable. These countries are considered particularly sensitive on food security grounds as their capacity to access food is directly dependent upon many factors such as: a) prices of food commodities on the international markets; b) prices of main export commodities on the international markets; c) macro-economic stability, including equilibrium of the balance of trade; d) efficiency of logistic facilities (transport, storage, distribution facilities etc); e) flexibility/resilience of domestic food sector to absorb or adapt to external shocks.

Flexibility and resilience of the domestic food sector and medium-long term equilibrium of the trade balance, are more difficult to achieve by those LIFDC which rely on imports for a significant part of their energy needs; particularly in situations where soaring oil bills due to increased oil and gas prices impose additional burden on the trade balance, domestic production costs and household budgets. For LIFDC net energy importers, external shocks on main import-export markets may lead to a significant and sudden worsening of the terms of trade with significant consequences in terms of macro-economic stability and welfare of the population. The international community has recently attributed great importance to external shocks as factors affecting the welfare of populations, due to "soaring food prices" in 2007-2008 and 2010-2011. This crisis was assumed to heavily affect poverty and food security in LIFDC [184].

---

[181] As classified by the World Bank (Atlas methodology), i.e. countries with a per capita Gross National Income (GNP) less than $ 3,595 (classification 2008, based on 2006 data). See: http://siteresources.worldbank.org/DATASTATISTICS/Resources/OGHIST.xls

[182] World Bank (2004): Global monitoring report. Policies and Actions for Achieving the Millennium Development Goals and Related Outcomes. World Bank, Washington, D.C.

[183] FAO UN classifies as "*Low-Income Food Deficit Countries (LIFDC)"* those countries: a) classified by the World Bank as "International Development Agency (IDA) eligible and 20 years IBRD loans" (Operational Lending Category II, i.e. per capita GNI less than 1,735 US$. Classification 2008 based on 2006 data); b) net (i.e. gross imports less gross exports) food trade position of a country averaged over the preceding three years. Trade volumes for a broad basket of basic foodstuffs (cereals, roots and tubers, pulses, oilseeds and oils other than tree crop oils, meat and dairy products) are converted and aggregated by the calorie content of individual commodities; c) Self-exclusion criterion (countries that meet the above two criteria but request to be excluded from the LIFDC category. See http://www.fao.org/countryprofiles/lifdc.asp

[184] The FAO UN, in partnership with other organisations, launched in December 2007 the "Initiative for Soaring Food Prices" (ISFP), aimed at reducing food insecurity generated in LIFDC by increasing food prices. See (FAO, 2008), Initiative for Soaring Food Prices: programme document, May 2008 FAO UN –Rome. (http://www.fao.org/isfp/isfp-home/en/) The ISFP sustained, among other things, the "Emergency Rice Initiative" in 11 countries in West Africa: Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Liberia, Mali, Mauritania, Nigeria, Senegal, Sierra Leone and Togo, aimed at "significantly

Much less emphasis, at least in terms of its impacts on development perspectives and welfare of LIFDC, was put on the soaring prices of energy (oil in particular) from 2003 to 2008.
However, while net oil exporting countries experienced huge windfall profits in respect of the 2003 base price, as reported by Bellù (2007), net importing countries had to afford additional oil bills, ranging between 1 % of their GDP in 2006 for most OECD countries up to almost 5% for selected LIFDC[185]. More than likely, these additional energy bills generated persistent macro-economic instability, decreased overall welfare of the population, increased poverty and hampered their long term development perspectives.

3. International price shocks and development: the case of Burkina Faso

Impacts of sudden and persistent shocks on prices of important import and/or export commodities on growth, income distribution, poverty reduction and, more in general, development perspectives, can be assessed by looking at specific country cases. In the next sections we explore the case of Burkina Faso, a LIFDC which has been recently considered by the international community as being among the "priority" countries for intervention to contrast negative food security consequences of soaring food prices.

Burkina Faso is a small, low-income food deficit country, a net importer of energy[186]. In addition, given its dimensions, Burkina Faso can be considered as a price taker on all the international markets in which it operates. This implies that this country is particularly vulnerable to external shocks.

To see to what extent price shocks on international markets affected Burkina Faso, the prices faced by the country of the main import-export commodities have been analysed. The price indexes in the last twelve years of cotton (for exports) and food, energy and fertilisers for imports are reported in figure 2. These indexes are based on international prices converted in local currency using annual average exchange rates and deflated with domestic GDP deflator (base year 2000). Given the impossibility of getting a complete time series of import and export prices for Burkina Faso, international nominal FOB prices in US dollars for fertilisers, cotton and oil were used as a starting point. The fertiliser price index is country specific, i.e. it was calculated on the basis of the prices of different types of fertilisers weighted with actual imports, derived from Customs data for 2005. Cotton, food and oil indexes are based on international composite prices[187].

---

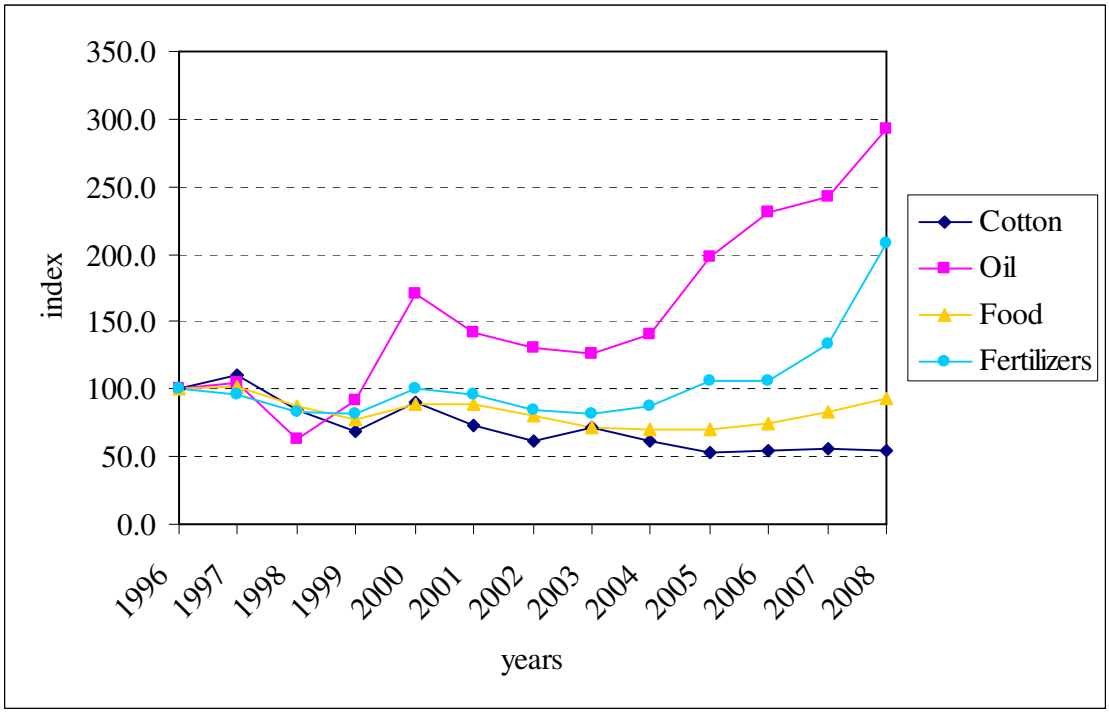
increase their rice production as of 2008 and 2009," (see Africa Rice Center (WARDA) www.warda.org.)

[185] Bellù (2007) reports that windfall profits in 2006 for example amounted to almost 16 % of GDP for Cameroon, 22% for Nigeria, 25% for Angola, 28% for Chad, up to almost 50% for Equatorial Guinea.

[186] Burkina Faso is also classified among the Least Developed Countries (LDC) by the UN and a "low-income" country also according to the classification of the World Bank.

[187] Adjustments of FOB prices with international freight costs to better reflect CIF prices were attempted on the basis of custom data 2005, reporting CIF prices 25% above FOB prices on average. These adjustments do not substantially change the overall picture and are not reported here.

Figure 2. Constant FOB price indexes for selected import and export commodities



Sources: Author's calculations based on: Cotton index: "Cotlook A index", Cotton Outlook (http://www.cotlook.com/information/cotlook_indices.php); Oil index: Composite Crude oil weighted by export volume. US Energy Information Administration http://tonto.eia.doe.gov/dnav/pet/hist/wtotworldw.htm; Food and fertilisers Indexes: FAO food price index and FAO (AGPC) indexes for various fertiliser types, UN Food and Agriculture Organization – Rome; GDP deflator and nominal average exchange rate FCFA/US$: IMF World Outlook Database, http://www.imf.org/external/pubs/ft/weo/2008/02/weodata/weoselgr.aspx

In spite of the fact that Burkina Faso was unanimously considered by the international community as a country particularly affected by the food crisis in 2008, having to benefit from immediate international support, there is insubstantial evidence of long term increases of food import prices and domestic prices of main staple food (cereals). The aggregated food import price index, based on the FAO food composite index shows an upward trend only from 2005 onward, which, in any case, always remains below the 1996 level.

However, the weights of the different food commodities in that index may not necessarily reflect the appropriate weights for Burkina Faso. Therefore, in order to better assess the food price changes faced by Burkina Faso, a further investigation of the actual domestic market prices was necessary. A domestic price index of staple food (the four main cereals: millet, sorghum, maize and rice), was built for both urban and rural populations using as weights the shares of actual households' expenditure, based on the most recent "household living standards survey", as reported in table 1.

Table 1: Consumption shares (quantities) of staple cereals by household location

	Household		Average	Average
	Urban	Rural	(LSMS)	(FBS-FAO)
Rice	30.1%	7.5%	11.0%	6.7%
Millet	12.8%	38.3%	34.3%	32.4%
Sorghum	13.7%	38.6%	34.8%	39.6%
Maize	43.4%	15.6%	19.9%	21.3%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: "Enquête sur les conditions de vie des ménages-2003" Institut National de la Statistique et Démographie (INSD)- Ouagadougou. Average weights (FBS-FAO) based on Food Balance Sheets (FBS), FAOSTAT, Food and Agriculture Organization of United Nations, Rome.

The price composite indexes of main cereals for rural and urban households in the last twelve years are reported in Figure 3. Their inspection confirms that overall, cereal prices did not substantially grow in the last decade. Nevertheless, the aggregate staple food index is characterised by:

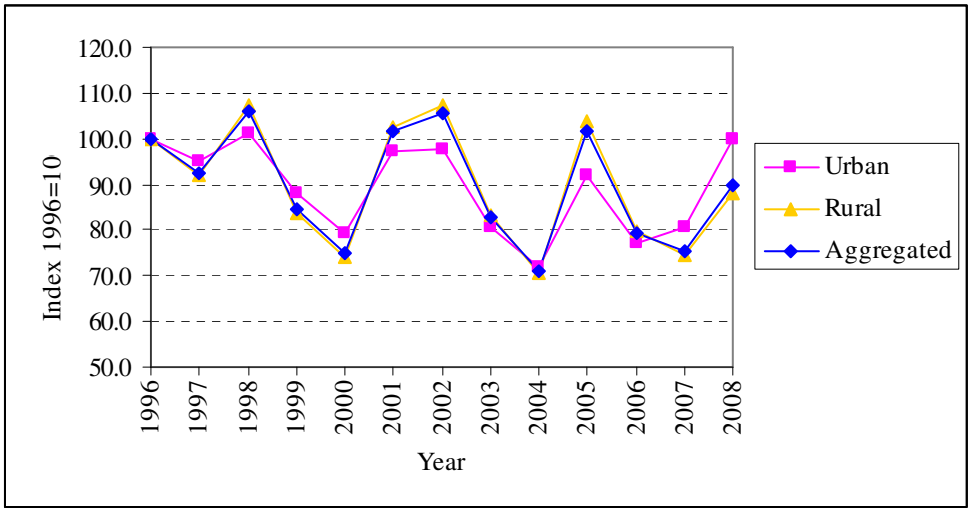
a) Sharp oscillations, showing higher prices in some periods (1996, 1998, 2001-02, 2005) and lower prices in subsequent ones (1997, 2000, 2004, 2006).
b) A significant increase (around 25%) from 2006 to 2008.

The absence of substantial shocks to the international food prices in real terms, i.e. at constant domestic prices until 2007, contributed to smooth domestic consumer prices of staple cereals. However on the one hand, rural households have been affected by greater price volatility than urban households, due to the higher share in consumption of domestic crops (more than 92%, comprising millet, sorghum and maize), characterised by more volatile prices (see table 1). On the other hand, since 2007, urban households experienced higher price increases instead due to the significant price increase of the imported component (30%, essentially rice).

Nevertheless, in spite of these oscillations, in 2008, "*the situation of food and nutrition of people is globally satisfactory. Even if prices are higher than those of last year, they are at a lower level than in 2005. The currently tend to stabilise, or even to drop on some markets.*" (Agrialerte, 2008)[188]

[188] Translated from (Agrialerte,2008) Alerte sur la situation de la campagne agricole des régions - Burkina Faso N°023-22/07/2008 Direction Générale des Prévisions et des Statistiques Agricoles (DGPSA), Direction du Système l'Alerte Précoce (DSAP) Ouagadougou. Information System on Food Security (SISA) www.sisa.bf

Figure 3. Consumer price index for cereals in urban and rural households (prices 2000)



Source: Author's calculations on data from the "*Direction Générale des Prévisions et Statistiques Agricoles – DGPSA*" Ouagadougou, for all prices, except: 1) price of Rice for 2007 (twelve months) and 2008 (period Jan-Mar): FAO report on Soaring food prices, May 2008. 2) Prices of millet, sorghum and white maize period Apr-Jul 2008: USAID, Famine Early Warning Systems Network (FEWSNET). West Africa Monthly bulletin of Cereal Prices, July 2008. 3) Consumer Price Index World Bank Development Indicators Database (2007 and 2008 refer to the GDP deflator). 4) Consumption weights for rural and urban households: Report on "Enquête sur les conditions de vie des ménages-2003" Institut National de la Statistique et Démographie (INSD)- Ouagadougou.

The relative stability of food prices strongly contrasts with the dramatic increase of real energy prices (essentially oil-based products and gas): they more than tripled since 1996. The long term growth of oil prices is associated with the more recent increase of fertiliser prices, which almost doubled in the last two years. On the other hand, the prices of cotton, the main export crop, following an almost steady long-term decline, fell in real terms by around 50%.

In order to assess the magnitude and depth of socio-economic impacts of these external shocks, it is necessary to explore the structure of the socio-economic system and the channels through which external shocks affect the economy. This will be done in two steps: 1) an analysis of selected macro-economic variables that will provide some insights into the importance of the main traded commodities; and 2) some simulations carried out with a Computable General Equilibrium model of the country that will allow assessment of the likely socio-economic impacts of these external shocks.

The following analyses will be based, among others, on the most recent Social Accounting Matrix (SAM) of Burkina Faso.[189] The SAM comprises 56 commodities, including 21 agricultural, 55 activities, five factors (agricultural labour, non agricultural labour, family labour, agricultural capital, non agricultural capital) four household groups (rural poor, rural non-poor, urban poor, urban non-poor), financial

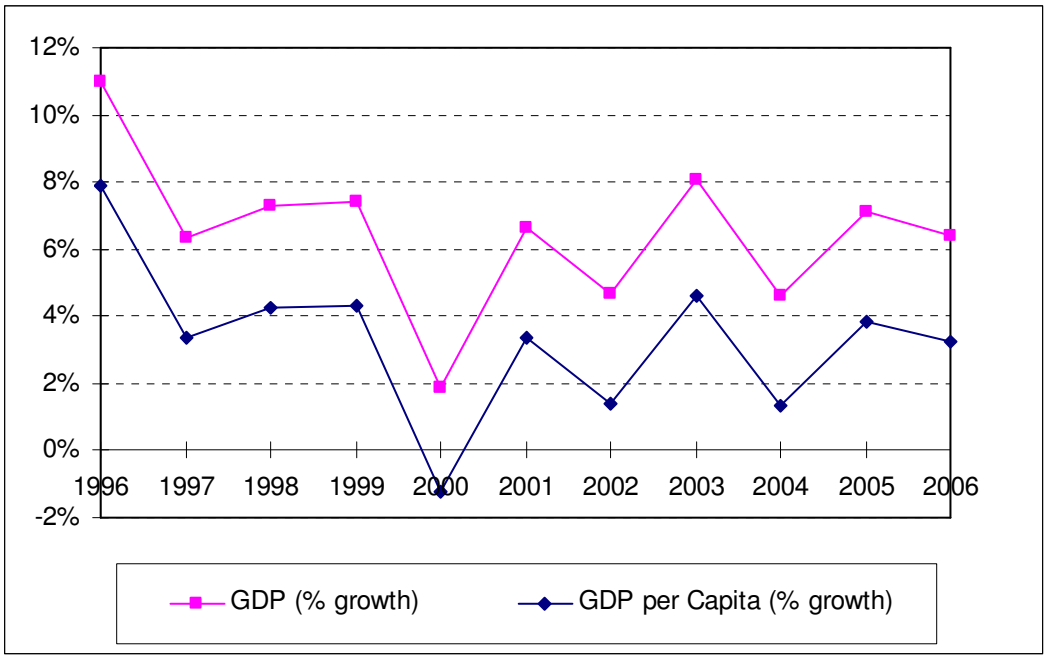
[189] Hebie, Mamadou (2007). Social Accounting Matrix of Burkina Faso, year 2000. Unpublished. Direction Générale des Statistiques et Prévisions Agricoles. Ministère de l'Agriculture, de l'Hydraulique et des Ressources Halieutiques (MAHRH). Ouagadougou. This is the only SAM available to date and was prepared in the context of a policy assistance project supported by FAO.

enterprises, non financial enterprises, plus the government account, the Savings-Investment account and the Rest of The World (RoW). It is based on the year 2000's national accounts data, including input-output data for different sectors, and household expenditures have been calculated based on the Living Standards Survey 2003.

4. The structure of the national economy

In the last decade, Burkina Faso has been characterised by non negligible annual GDP growth rates, ranging from 5% for GDP and 2% for GDP per capita (see figure 1). The fastest growing sector was industry, (9.5% per year) followed by services (5.4%) and agriculture (less than 5%).

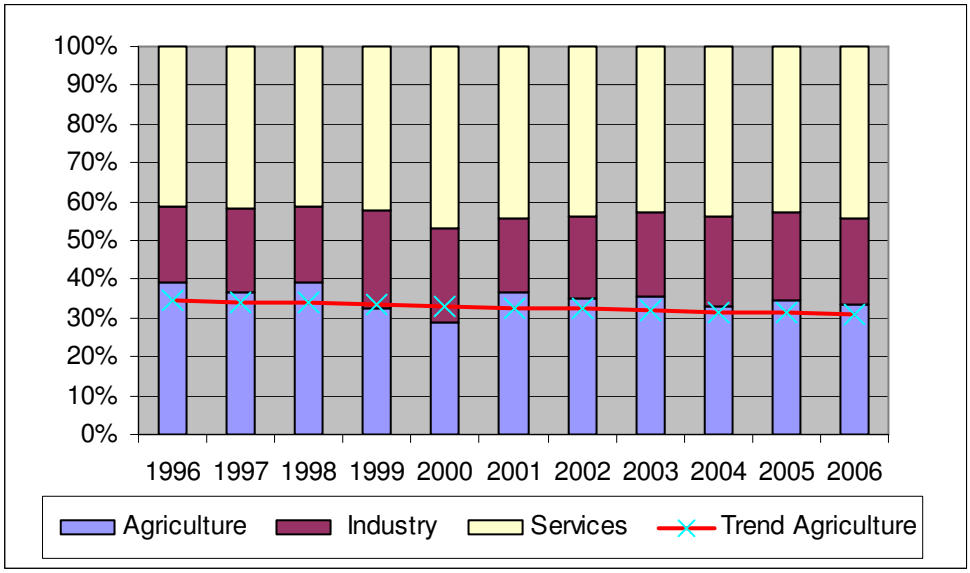
Figure 3: GDP and per capita GDP growth rates (GDP at constant FCFA)



Source: Own elaborations on: World Development Indicators, World Bank

As a consequence of this differentiated growth, Burkina Faso, as well as other countries in West Africa, is changing, little by little, its productive structure, where industry and services have more weight than agriculture.

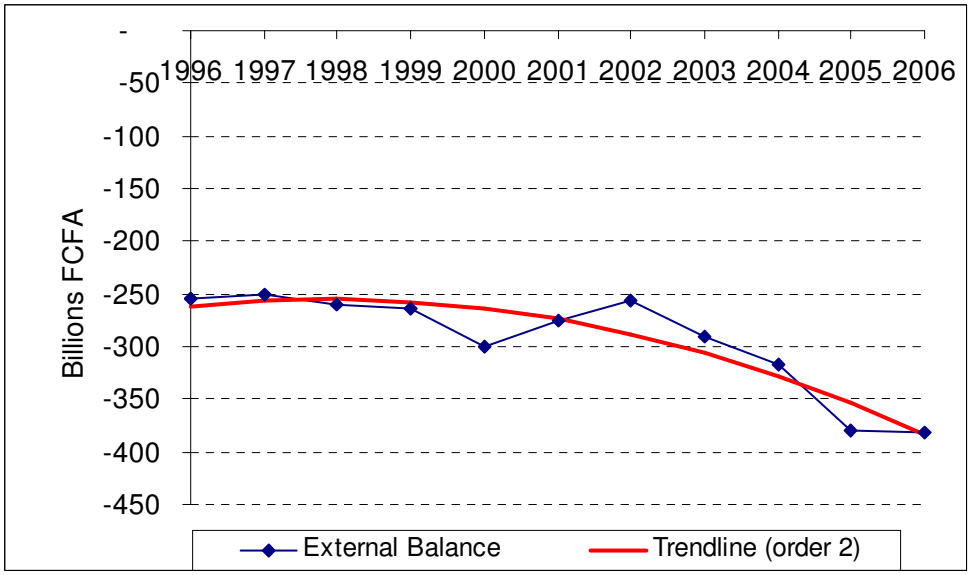
Figure 4: Value added by sector (shares of GDP, nominal).



Source: Author calculations on: World Development Indicators, World Bank.

The sustainability of growth is, however, jeopardised by external macro-economic imbalances. For example, the external balance of goods and services, which started recovering after 2000, significantly deteriorated in 2002, and a further increase of the deficit is expected for 2007.

Figure 2. External Balance of goods and services. Constant billions FCFA (year 2000)

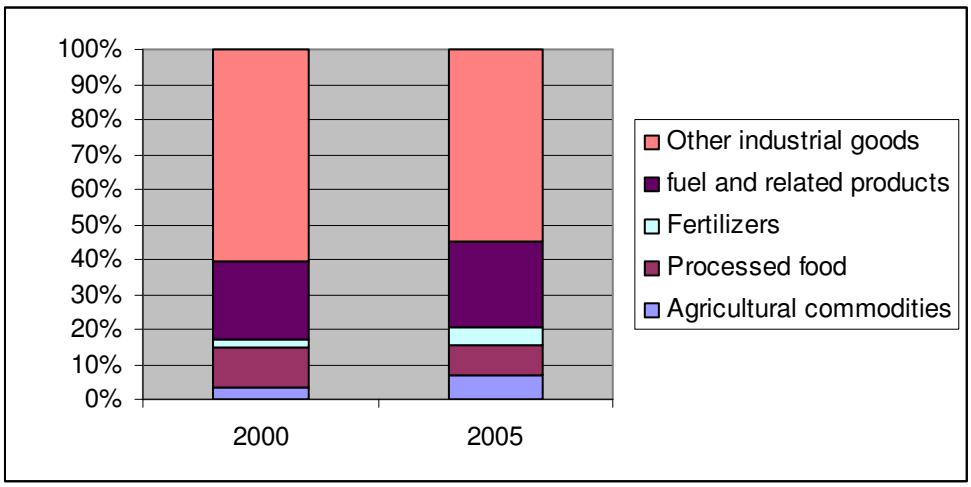


Source: Author's calculations on: World Development Indicators, World Bank (external balance in nominal FCFA) and IMF world outlook (GDP deflator at year 2000 prices).

This increased deficit is essentially due to imports growth no longer being compensated by exports.

The analysis of the structure of imports in the SAM 2000 and an inspection of custom data for 2005 reveals that the bulk of imports in the country comprises industrial goods, with a growing weight from 2000 to 2005 of chemicals; including fertilisers and pesticides, and oil-related energy products, as reported in figure 3. Agricultural commodities and processed food items do not play a major role as they comprise around 15% of total imports. This situation looks quite stable in different years, as the only significant change between 2000 and 2005 is the increased weight of raw commodities with respect to processed food. This is essentially due to the increased imports of rice.

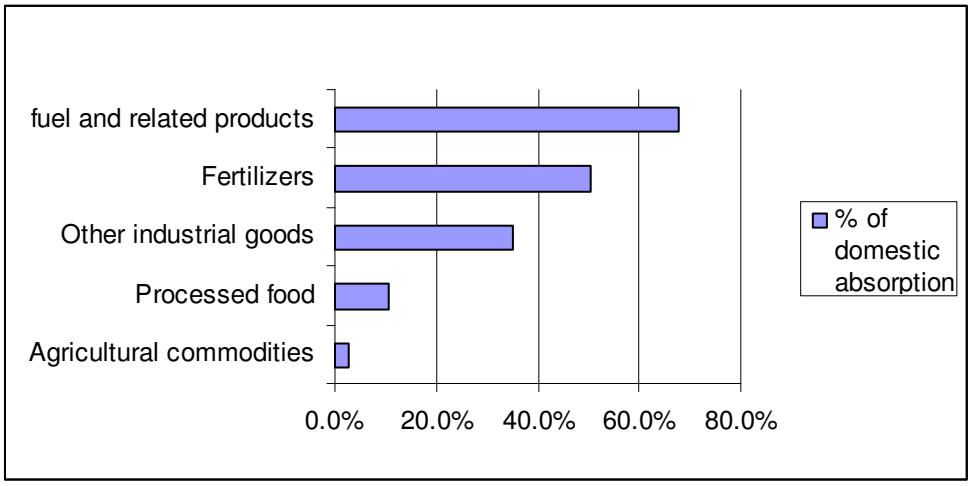
Figure 3: Imports by commodity as % of total imports (years 2000 and 2005)



Sources: Social Accounting Matrix for year 2000 and author elaborations on Customs data for year 2005.

Looking at the role of imports in respect of the domestic absorption, as reported in figure 4, it is apparent that, overall, agricultural commodities and processed food imports are marginal related to the domestic output of the same commodities, as they represent less than 3% and 11% respectively of the total supply. In contrast, this is not the case for industrial goods, where imports cover almost 45% of the total supply. Specifically, fuel and fuel-related products are essentially totally imported (68% of the value of supply is imported, while the remaining 32% is due to domestic trade margins, taxes and distribution costs.

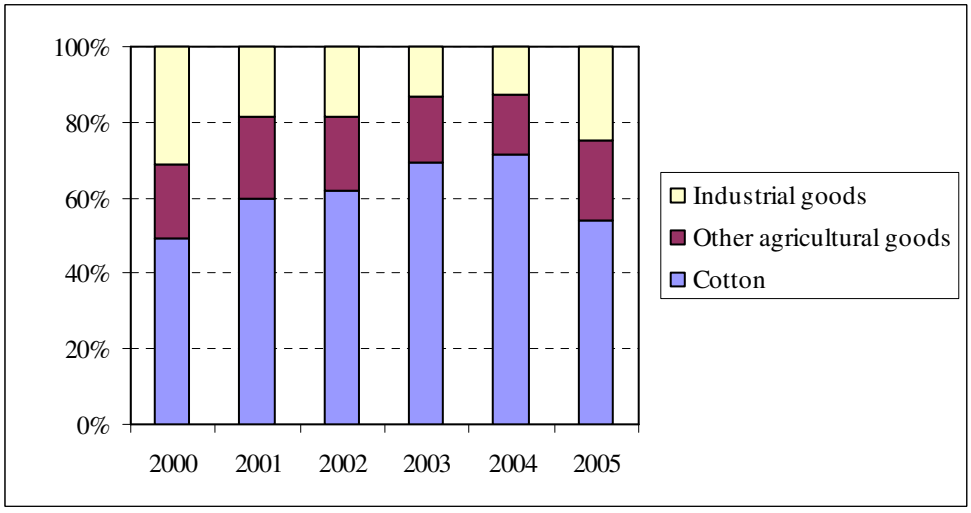
Figure 4: Imports by commodity, as % of domestic absorption, year 2000.



Source: Social Accounting Matrix, year 2000.

On the export side, Burkina Faso is almost a "single-commodity" trader. Cotton covers among 50% and 70% of export revenues in recent years, as reported in figure 5.

Figure 5: Exports by main commodity groups.



Source: Years 2000 and 2005: SAM-Burkina. Years 2001 to 2004: Author's calculations on data from: International Trade Centre UNCTAD/WTO http://www.intracen.org/tradstat/

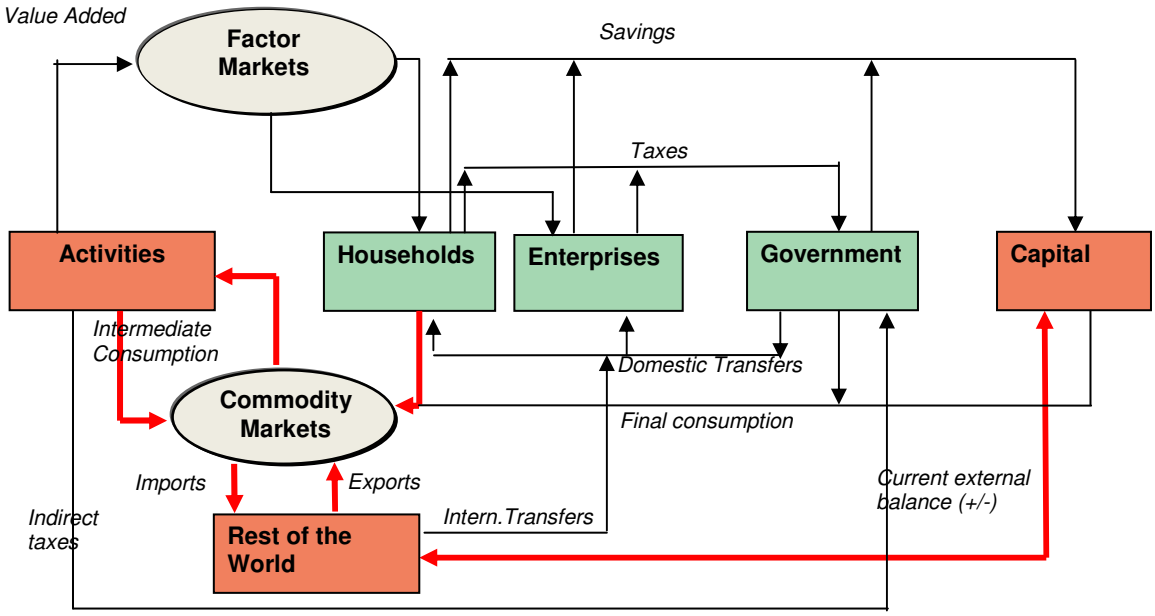
Given the overarching role of cotton in exports, the continuous fall of its real price in recent years (with the exception of 2003) represented a real loss of income to the country.

It is expected that the loss of income from cotton, in addition to the increased energy and fertiliser bills, has very likely negatively affected the growth perspectives and welfare of different social groups in a diversified way, through multiple flows of payments originated by income generation, income distribution and expenditure processes.

Figure 6 provides a schematic view of the flows of payments among the different economic entities through which external shocks are likely to affect the socio-economic system.

Upward shifts in oil prices, for example, other things being equal, lead to increased input costs for the activities utilising those imports as intermediate consumption and for households directly using oil products. This leads to increased prices of outputs produced using oil products, in particular those produced with energy intensive production processes. Increased output prices imply, other things being equal, reduced real income of institutions. In addition, increased import prices lead to a worsening of the balance of trade, particularly if import substitution by means of domestic products is difficult. Furthermore, upward price shifts will activate behavioural reactions such as substitution in consumption towards relatively cheaper goods and services; affecting in turn the output of the activities producing the different types of goods. Upward and downward shifts of activities will then affect the demand of factors and related payments to factors. This will have implications for households' incomes.

Figure 6. Main flows of payments through which external shocks affect the economic system (in red).



Source: adapted from: Round J. (2003): Social Accounting Matrices and SAM-based multiplier analysis", chapter 14 in F. Bourguignon and L.A Pereira da Silva (Eds) The impact of economic policies on poverty and income distribution, New York, World Bank and Oxford University Press.

On these grounds, it is most likely that different socio-economic groups are affected differently, according to, for example. their geographic location (rural versus urban) or their welfare status (poor versus non-poor). To analyse the extent to which price changes on the international markets affected the different layers of the populations, and to investigate the distributional impacts of possible countervailing policy measures, it is necessary to dispose of a framework comprising the abovementioned factors and related interlinking channels. The SAM 2000 allows some considerations to be drawn about the distributional impacts of shocks and policies because in the

SAM households are classified in Rural-Urban and Poor-Non poor according to their residence and the national per capita annual poverty line[190]. In the following paragraphs a short description of the household classification is provided.

The SAM 2000 bases its classification of households on the "Survey on the Living Standards of Households" run in 2003 by the INSD[191]. INSD (2003) adopted an absolute poverty line for the period April-July 2003 The poverty line, calculated on the basis of minimum calories intake and minimum-non food requirements, amounts to 82 672 FCFA per person per year, corresponding to around one fourth of the legal minimum wage and around two fifths of the international poverty line of one dollar per person per day. The INSD survey allows the classification of the population and the households as reported in table 2.

Table 2. Rural-Urban and Poor/Non-Poor Classification of Population and Households

# Population	Poor	Non poor	**total**
Rural	4,869,012	4,446,348	**9,315,360**
Urban	412,010	1,656,435	**2,068,445**
total	**5,281,022**	**6,102,783**	**11,383,805**

% Population	Poor	Non poor	**total**
Rural	52.3%	47.7%	**100.0%**
Urban	19.9%	80.1%	**100.0%**
total	**46.4%**	**53.6%**	**100.0%**

# of Households	Poor	Non poor	**total**
Rural	612,770	794,670	**1,407,441**
Urban	54,155	315,440	**369,595**
total	**666,925**	**1,110,111**	**1,777,035**

% Households	Poor	Non poor	**total**
Rural	43.5%	56.5%	**100.0%**
Urban	14.7%	85.3%	**100.0%**
total	**37.5%**	**62.5%**	**100.0%**

Source: Own calculations on INSD data from "Enquête sur les conditions de vie des Ménages» (2003) And INSD (2003): «La Pauvreté'au 2003»

The survey data also allow the analysis of the expenditure by type of household, as reported in table 3. This analysis reveals that, overall, the urban layer of the society looks more polarized than the rural one, as the difference in the average expenditure between poor and non poor is lower in rural areas than in urban ones. In addition, although much more widespread, rural poverty is on average less deep than urban poverty, as rural poor households spend on average more than their homologues in urban areas (423,000 and 372,000 FCFA per year, respectively). On the other hand, the average expenditure of non poor is higher in urban areas than in rural ones.

[190] The per capita poverty line was estimated by INSD (2003) at 82 672 FCFA for 2003.

[191] INSD (2003) Analyse des résultats de l'Enquête sur les Conditions de vie des ménages Burkina Faso. Ministère de l'Economie et du développement. Segretariat General, Insitut National de la Statistique et de la Démographie (INSD)
INSD (2003) : Profile de la Pauvreté en 2003. Ministère de l'Economie et du développement. Segretariat General, Insitut National de la Statistique et de la Démographie (INSD)

Table 3: Average household expenditure by type of household.

Average exp*	Poor	Non poor	**total**
Rural	423	874	678
Urban	372	1,484	1,321
total	419	1,047	811

* Thousands FCFA per household per year

Average exp*	Poor	Non poor	**total**
Rural	52%	108%	**84%**
Urban	46%	183%	**163%**
total	**52%**	**129%**	**100%**

* % of national average household expend. year 2000

Source: Social Accounting Matrix of Burkina Faso for year 2000.

In addition to the expenditure level, the structure of expenditure may also lead to differentiated impacts of external shocks and related policies on the different types of households.

Table 4. Expenditure shares by type of households

	Rural Poor	Rural non-poor	Urban Poor	Urban non-poor	Notes: SAM code
Agricultural commodities	**43.9%**	**25.2%**	**30.5%**	**16.3%**	
Fruits and vegetables	*13.9%*	*6.7%*	*9.0%*	*5.3%*	CAGEX,CAMAR,CAGOT
Cereals	*17.5%*	*10.9%*	*10.5%*	*6.5%*	CAGFO
Meat and Fish	*12.6%*	*7.5%*	*10.9%*	*4.6%*	CBOV,CCATF,CCHAS,CFISH
Processed food	**26.4%**	**31.1%**	**26.5%**	**21.3%**	CNAFO+CABAT
Other Primary commodities	**1.8%**	**2.6%**	**3.6%**	**2.1%**	CFORE+CMINE
Industrial goods	**19.1%**	**20.3%**	**23.3%**	**24.6%**	
Fuel, related products and energy	*6.7%*	*6.6%*	*9.0%*	*8.3%*	CPPTR,CENEG
Other industrial goods	*12.5%*	*13.6%*	*14.2%*	*16.4%*	CNAOI
Services	**8.8%**	**20.9%**	**16.1%**	**35.7%**	
Transport	*1.4%*	*2.2%*	*1.9%*	*1.5%*	CTRANS
Other services	*7.4%*	*18.7%*	*14.3%*	*34.1%*	CFINAN,CNASM,CNASNM
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	

Source: Social Accounting Matrix of Burkina Faso for year 2000.

Looking at table 4, as expected, the percent of food expenditure on the total expenditure is higher among the poor than among the non-poor. This holds both for rural and urban layers of the population. Furthermore, the rural poor spend more on raw (unprocessed) food than the other types of households. On the other hand, the share of expenditure on industrial goods is fairly similar across the different households, ranging from the 19.1% of the rural poor to the 24.6% of the urban non-poor. This also applies to the expenditure for fuel and energy. This implies that the difference in the share of food expenditure is complemented by the differences in the expenditure on services. The share of the non-poor, in particular the urban ones, is much higher than the share of the poor (35.7% and 8.8% respectively).

The different structure of expenditure across households, associated with the different expenditure levels and likely diversified behavioural responses of the various social groups described above, should result in differentiated welfare impacts of different external shocks and related policy measures. The CGE model, described in the next section, will be used to shed some light on the cross-sectoral and inter institutional socio-economic impacts of external shocks and possible related policy measures.

5. The CGE of Burkina Faso

The CGE model adopted for Burkina Faso is based on the standard IFPRI CGE (2002)[192]. This is a single-country, multi-sector, multi-commodity open-economy static model, based on a SAM of the country, essentially used to calculate selected parameters and "calibrate" the model in such a way that its solutions, in absence of shocks, replicate the solutions of the variables at the benchmark. In this section, some important features of the model will be illustrated. A detailed description of the structure and selected blocks of the model in reported in appendix.

5.1. Data sources

The SAM described in the section above has been utilised as the base of macro-economic data for the CGE model. The SAM has been aggregated in larger groups of commodities and macro-production sectors (activities) to rule out small value cells in order to ease the convergence of the model.

In addition, the SAM was modified to highlight the expenses for agricultural chemicals (fertilisers and pesticides), because the original SAM reported only the production and use of an aggregated commodity: "other industrial goods". The payments of the agricultural sectors to the account of this aggregated commodity were assumed to be payments for agricultural chemicals. This assumption allowed the separation these expenses from the rest of the expenses for other industrial goods. The commodities, activities and institutions comprised in the SAM are reported in table 5.

[192] Lofgren H, Lee Harris R, Robinson S. et al.(2002) A standard Computable General Equilibrium (CGE) model in GAMS. International Food Policy Research Institute, Washington D.C.

Table 5. Aggregated SAM elements for the CGE model.

#	Activities	Code
1	Cotton grains	ACOTN
2	Cash crops	AAGEX
3	Vegetables	AAMAR
4	Food crops	AAGFO
5	Other Agriculture	AAGOT
6	Livestock-bovine	ABOV
7	Other livestock	ACATF
8	Hunting	ACHAS
9	Forestry	AFORE
10	Fisheries	AFISH
11	Mining	AMINE
12	Cotton ginning	AEGRC
13	Slaugthering	AABAT
14	Agro-industry	ANAFO
15	Other industry	ANAOI
16	Power, water and gas	AENEG
17	Trade	ACOME
18	Transport	ATRANS
19	Financial ervices	AFINAN
20	Services to enterprises	ANASM
21	Services to households	ANASNM

#	Commodities	Code
1	Cotton grains	CCOTN
2	Cash crops	CAGEX
3	Vegetables	CAMAR
4	Food crops	CAGFO
5	Other Agriculture	CAGOT
6	Livestock-bovine	CBOV
7	Other livestock	CCATF
8	Hunting	CCHAS
9	Forestry	CFORE
10	Fisheries	CFISH
11	Mining	CMINE
12	Cotton ginning	CEGRC
13	Slaugthering	CABAT
14	Agro-industry	CNAFO
15	Other industry	CNAOI
16	Oil and oil products	CPPTR
17	Fertilizers and Pesticides	CFERT
18	Power, water and gas	CENEG
19	Trade	CCOME
20	Transport	CTRANS
21	Financial services	CFINAN
22	Services to enterprises	CNASM
23	Services to households	CNASNM

#	Institutions/ other accounts	Code
1	Poor rural households	HLSLOW
2	Non-poor rural households	HLSUPP
3	Poor urban households	HURBLOW
4	Non-poor urban households	HURBUPP
5	Financial enterprises	ENTRF
6	Non-financial Enterprises	ENTRNF
7	Income taxes on households	YTAX
8	Indirect taxes on activity incomes	ATAX
9	VAT and other taxes on goods	TAR
10	Import taxes	ITAX
11	Export taxes	ETAX
12	Government account	GOV
13	Rest of the World	ROW
14	Savings-Investment account	S-I

#	Factors	Code
1	Agricultural labour	LABAGR
2	Non-agricultural labour	LABNAGR
3	Family labour	MOF
4	Agricultural capital	CAPSH
5	Non agricultural Capital	CAPLSC

The SAM was used to obtain share parameters and scale factors for almost all the demand and supply functions included in the model.

In the absence of more detailed information, we adopted a Leontief technology (fixed technical coefficients) based on SAM information, for the following levels of the "technology nest":

1. determination of the composite intermediate input;
2. determination of the value-added mix.

In addition to information contained in the SAM, different sets of elasticities were used for:

1. substitution of domestic goods versus imports (Armington-type CES function elasticities);
2. transformation of domestic consumption goods into exports (CET function elasticities);

3. own, cross-price and income elasticities for households. (LES demand system, with "subsistence" consumption shares. An estimate of the Frisch parameter was obtained from the literature).
4. determination of the aggregated value added is obtained (CES function allowing for imperfect substitutability among factors).

For more details on the equations of the model regarding the demand system for final consumers the import/domestic substitution and the export/domestic transformation, see the technical appendix at the end of the paper.

Elasticities have been derived from available literature, in the absence of relevant information at country level. Given that the choice of elasticities introduced some degree of subjectivity in determining the behavioural responses of agents to shocks and policy measures; some sensitivity analysis on the most relevant parameters for the specific measures under investigation were carried out, to also take into account the very different estimates identified in literature[193].

5.2. Macro-economic closures

The model requires some "macro-economic closures", i.e. we need specifying the ways by which relevant macro-economic balances are satisfied. More specifically this applies for the following macro-economic balances:

1) government account balance;
2) Rest Of the World (ROW) account balance;
3) Savings/Investment (S-I) account balance.

1) Government account balance (deficit/surplus). The government revenue (*YG*) has to be equal to the government expenditure (*EG)* plus the government savings (*GSAV*):

$$YG = EG + GSAV \ . \qquad (6.1)$$

In the model, the income of the government *YG* comprises taxes on income of institutions and other income:

$$YG = TINS \cdot YI + FTRANSF * EXR + OTHIG \qquad (6.2)$$

where:

TINS:	Vector of institution-specific tax rates;
YI:	Vector of incomes of non-governmental institutions;
FTRANSF	Foreign transfers to the government (in foreign currency);
EXR	Real exchange rate (expressed in terms of the price numeraire);
OTHIG:	Other government income.

The government expenditure *EG* comprises government consumption and transfers:

$$EG = QG \cdot PQ + Transf \cdot CPI \qquad (6.3)$$

[193] To this regard see e.g. Gibson. K. (2003) Armington Elasticities for South Africa. Long and Short Run level Estimates. Trade and Industrial Policy Strategies Working paper 12-2003 University of Natal (South Africa).

where *QG* is a vector of "real" government consumption (government consumption in physical terms), PQ the vector of commodity prices and *Transf* are public transfers to non-governmental institutions.
The consumption component of the government expenditure $QG \cdot PQ$ is modelled either by fixing QG in real terms (for instance, anchored to the base year), or by fixing it as a given share of the nominal total absorption[194]. Transfers are exogenous but are kept constant in real terms for the consumers through the different simulations by multiplying them by the consumer price index *CPI*. The government balance adjusts by means of one of the following options:

a. **Flexible government savings** and fixed tax rates. Government savings adjust to the new level of taxes calculated with new incomes, existing tax rates and new nominal government consumption.
b. **Fixed government savings** and flexible taxation, by means of fixed adjustments in the tax rates for selected institutions.
c. **Fixed government savings** and flexible taxation by means of proportional adjustments in the tax rates for selected institutions.[195]

2) Rest of the World (RoW) account. The external balance, specifically the current account deficit/surplus, expressed in the model in foreign currency, is as follows:

$$QE \cdot PWE - QM \cdot PWM + tr(F,ROW) - tr(ROW, F) + FTRANSF = -FSAV \quad (6.4)$$

where:

QE:	Vector of exported quantities
PWE:	Vector of world export prices (in foreign currency)
QM:	Vector of imported quantities
PWM:	Vector of world import prices (in foreign currency)
tr (F,ROW):	Transfers from the ROW for the payments of domestic factors
tr (ROW, F):	Transfers to the ROW for the payments of foreign factors
FTRANSF	Transfers from ROW to government
FSAV:	Foreign savings (deficit/surplus of the current account)

The left-hand side of 6.4 is the "current account balance" as defined in UN (1993)[196]. Note that $FSAV > 0$ implies a deficit of the current account balance; vice versa, $FSAV < 0$ implies a surplus of the current account.

[194] This implies that the scale factor (variable GADJ) which shifts the vector of quantities consumed by the government, and which is exogenously fixed when QG is exogenous, is endogenized. In any case, the proportions among the physical commodities consumed by the government are the same as in the base case.
[195] For example, given institution A with a tax rate of 20% and institution B with a tax rate of 15%, under the closure b., a required tax change of e.g. +7% for both institutions leads to new tax rates of 27% and 22% for A and B respectively. Under the closure c. instead, a required tax change of e.g. +40%, leads to new tax rates of 28% and 21% for A and B respectively.
[196] The current account balance, as defined in the Systems of National accounts (1993) includes The *goods and services account* (the overall trade balance) The *primary income account* (factor income such as from labour, loans and investments) The *secondary income account* (transfer payments).

Options for its equilibrium are:

a. **Fixed foreign savings and flexible real exchange rate**[197]. In this case, the equilibrium in the external balance is achieved by depreciating (appreciating) the local currency, i.e. increasing (decreasing) the price of the foreign currency in real terms, to compensate for a deficit (surplus) of the trade balance which exceeds the fixed foreign savings level. Assuming that world prices are exogenously fixed, the depreciation (appreciation) of the foreign currency implies that imports become more expensive (cheaper) w.r.t. domestic goods and exports are more profitable (less profitable) than domestic sales, entailing an adjustment of quantities imported and exported (via the Armington and CET functions. Fixing the foreign savings in foreign currency, when the balance of transfers from and to abroad is exogenous, implies also fixing the balance of trade in foreign currency. Overall, this closure amounts to:

$$QE \cdot \overline{PWE} - QM \cdot \overline{PWM} + \overline{tr\,(F,ROW)} - \overline{tr\,(ROW,\,F)} + \overline{FTRANSF} = -\overline{FSAV} \quad (6.5)$$

Note however that the variable *FSAV* represents a "net" flow of foreign financial resources, resulting from the balance of inflows and outflows. While the inflow component may be related to the capacity of the country to attract new capital from abroad, the outflow component is directly linked to the investment choices of domestic investors. On these issues, see e.g. Taylor (2004)[198] The assumption of 'exogeneity' of *FSAV* therefore has to be considered only as one possible modelling option in absence of further information regarding the way capital inflows and outflows are determined. For this reason, the level of *FSAV* may be subject to sensitivity testing.

b. **Flexible foreign savings and fixed exchange rate**. Under this option the exchange rate is implicitly anchored to the numeraire of the system and the external current account balance is adjusted by means of flexible foreign savings. In this case, the foreign savings adjust to compensate for imbalances in the trade account.

A discussion on the implications of the different types of closure of the external balance is reported in appendix B, section 13.4.

3) Savings/investment account[199]: The Savings-investment balance is represented by the following relation:

[197] Real exchange rate refers here to the price in local currency of one unit of foreign currency expressed at constant domestic prices.

[198] Taylor L. (2004). Reconstructing macroeconomics: structuralist proposals and critiques of the mainstream Ch 10. Harvard University Press, 2004.

[199] The model adopted allows for two options for the variation of the average propensity to save MPS: a) "uniform fixed points saving rate change", through the adjustment of the parameter DMPS and b) "proportional saving rates change" through the adjustment of the parameter MPSadj, as follows:
MPS = mps0*(1 + MPSadj) + DMPS

$$YI \cdot (1 - TINS) \cdot MPS + GSAV + FSAV \cdot EXR = QINV \cdot PQ$$
(6.6)

where:

YI a vector of incomes of the different non-governmental institutions;
TINS a vector of institution-specific tax rates for non-governmental institutions;
MPS a vector of institution-specific average propensities to save;
GSAV savings of the government;
FSAV foreign savings in foreign currency;
EXR exchange rate;
QINV vector of physical quantities of investment commodities;
PQ vector of commodity prices.

This balance adjusts by means of one of these options:

a. **Fixed investment (in physical terms) and flexible savings** by means of fixed adjustments of the average propensity to save for selected institutions. For example, given two institutions, A and B, with an average propensity to save 10% and 15% respectively, a required change in the savings is obtained by an additional fixed number of percentage points equal for both the institutions: say 5%, in their propensity to save, leading to 15% and 20% for A and B respectively.
b. **Fixed investment (in physical terms) and flexible savings** by means of proportional adjustments of the average propensity to save for selected institutions, e.g. given the two institutions A and B above, a required change in the savings is obtained by a proportional change in the average propensities to save equally for both the institutions: say 20%, in their propensity to save, leading to 12% and 18% for A and B respectively.
c. **Flexible investment and fixed savings** with fixed marginal propensity to save for non-government institutions;
d. **Fixed investment share of absorption and fixed government consumption share** of absorption. Absorption is expressed in value terms. This implies that quantities for investments and government consumption are flexible. The propensities to save adjust as in case a.
e. **Fixed shares as above**. The propensities to save adjust as in case b.
f. **Fixed investment and flexible savings**, by means of adjustments of income. Average propensities to save are fixed, but shifts in income by means of the "Keynesian multiplier" effects allow savings to adjust to investment ("Keynesian-type" closure)[200].
g. **Fixed investment and flexible savings**, by means of adjustments in the income distribution. This closure requires that at least two institutions with different propensities to save. This is a "Postkeynesian-type" adjustment mechanism (Kaldor-Pasinetti).
h. **Fixed investment and "compulsory" savings.** Government savings adjust to satisfy the S-I balance (this is a "Johansen-type"adjustment mechanism).

[200] For a discussion on the different types of closure mechanisms, see the appendix B (chapter 13).

Simulations reported in the present study adopted the following macro economic closures (see figure 6):

1. **Government balance:** flexible government savings (fixed direct tax rates), This option is likely to be better at fitting the actual situation of the country. Indeed, analysing the impact of external shocks and policy measures on tax rates, with the aim of identifying appropriate tax rates to enable the maintenance of a fixed budget deficit, would be a pure theoretical exercise, given the context of the country. Adjustments of tax rates and fiscal policies in general would actually be difficult to implement in practice, given the weak institutional structure, including the fiscal administration. In addition, by imposing flexible government saving, it will allow a focus on welfare changes induced by external shocks and policy responses, not "polluted" by fiscal adjustments. In all the simulations carried out in this work government consumption is fixed at the base level. However, changes in relative prices shift the government expenditure

2. **RoW account**: flexible real exchange rate and fixed foreign savings (fixed deficit of the trade balance, expressed in foreign currency) are chosen as the closure rules for the RoW account.[201]. Therefore, real import/export prices will be affected, in addition to shifts due to external shocks, also by shifts of the real exchange rate. This implies that imbalances in the Rest of the World account generated by external shocks are absorbed by adjustments of the real exchange rate and not by foreign savings.

3. **Savings-Investment (S-I) account:** regarding the Saving-Investment balance, the macro-economic closure rule chosen is "investment-driven". Investment has been kept fixed in real terms (fixed quantities). Average propensities to save of households adjust to fit investment requirements. This permits looking at the pure impact on welfare of households and comparing it with the base case, after neutralising possible changes in the capital formation. This closure implies that the economic system is not shifting the burden of current shocks in the future, because is not affecting its capital formation.

The above-mentioned macro-closures, on the basis of equations 6.1 to 6.6 can be represented as follows:

[201] Burkina Faso belongs to the "Union Economique et Monetaire de l'Afrique de l' Ouest" (UEMOA), which adopted the Franc CFA, a common currency anchored in nominal terms to the Euro. Unilateral nominal devaluations of the national currency are not possible. The "currency devaluations" reported in the results of the simulations in the next sections have to be intended as increases of the level of foreign prices with respect to domestic ones or, analogously, reductions of the general level of domestic prices relative to foreign prices that would enable to keep constant the deficit of the trade account expressed in foreign currency with respect to the base case. A more in depth discussion regarding the closure of the RoW account is reported in annex.
An alternative scenario for the real exchange rate could be to introduce some real appreciation, say, around 1.5% per year, to reflect the actual trend of this variable in recent years, as reported in Joufelkit H.D. (2005): Evolution des taux de change effectifs réels (TCER) de la zone franc: 1993-2006. Rapport "Jumbo", Agence Française de Développement (AFD)-Paris.

Ext.
bal.: $QE \cdot \overline{PWE} - QM \cdot \overline{PWM} = \overline{tr\,(ROW,\,F)} - \overline{tr\,(F,ROW)} - \overline{FTRANSF} - \overline{FSAV}$
(6.7)

S-I bal: $YI \cdot (1 - \overline{TINS}) \cdot MPS + GSAV + \overline{FSAV} \cdot EXR = \overline{QINV} \cdot PQ$
(6.8)

Gov.bal.: $\overline{TINS} \cdot YI + \overline{FTRANSF} * EXR + OTHIG = \overline{QG} \cdot PQ + \overline{Transf} \cdot CPI + GSAV$
(6.9)

When exogenous shifts of world prices, either PWE or PWM, are simulated, the equilibrium of the external balance (6.7) is altered. Under this closure, the only endogenous variables in the balance are the physical quantities of imports and exports *QE* and *QM*, in the trade balance on the left hand side of equation 6.7. Note that, under this closure, the trade balance is exogenously fixed, as all the components on the right hand side of the 6.7 are exogenous. Therefore, *QE* and *QM* have to adjust upward or downward to restore the equilibrium. As explained above, this happens by means of:

a. shifts of relative domestic prices of commodities whose world prices change;
b. a shift of the exchange rate *EXR*, implying a general shift of domestic versus world prices.

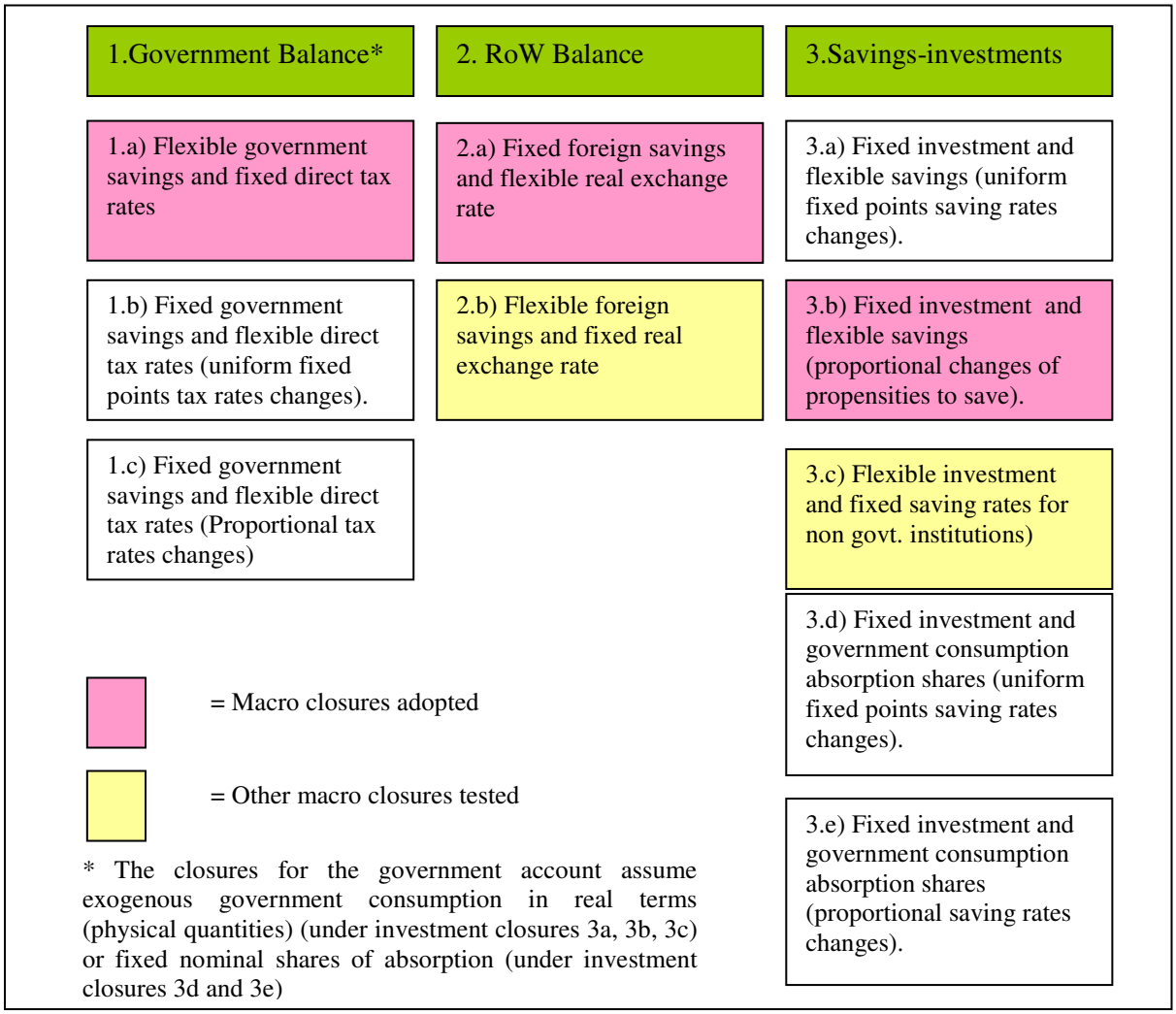
The shifts of import-export commodities affect consumer prices and the consumer price index *CPI*. However, note that, being *CPI* the numeraire, only relative prices shift up or down. Price shifts lead to changes in the composition of the domestic demand. As a consequence, as the different commodities are produced with technologies which exhibit different factor intensities, shifts of demands lead to shifts activity levels, factor use and/or shifts in factor remunerations (wages) (according to the specific closures of factor markets, as discussed in the section 6.3 here below), which lead to changes in the income of the various institutions *YI*.

On the one hand, the shift of the exchange rate *EXR* and, probably to a lesser extent, of incomes *YI* and prices *PQ* alter the S-I balance (equation 6.8). An upward shift of the exchange rate shifts upward foreign savings in domestic currency (and vice-versa, a downward shift). This implies that, other things equal, either the government savings *GSAV* or the average propensities to save of private institutions *MPS* (or both) have to adjust downward to restore the S-I balance.

On the other hand, the shift of *EXR* described above, in addition to changes of the government savings *GSAV*, of income *YI*, as well as changes in other government income *OTHIG*, alters the government balance (equation 6.9) by shifting the value of foreign transfers to government expressed in domestic currency. For example, an upward shift of the exchange rate increases the value of (positive) foreign transfers expressed in domestic currency. Other things equal, *GSAV* should increase to restore the government balance expressed by equation 6.9. The remainder of the burden in the restoration of the government balance is born by changes of the relative prices *PQ*. However, note that adjustments of *GSAV* required for satisfying equation 6.8 have to be compatible with adjustments of the same variable to satisfy equation 6.9. In the case of an upward shift of the exchange rate, the shift of *GSAV* required to satisfy the government balance (equation 6.9) has the opposite sign of the shift required to restore the S-I balance (equation 6.8). The ultimate sign of the change in *GSAV*

depends, other things equal, by the magnitude of *FTRANSF*. In presence of relatively high transfers from abroad, an upward shift of the exchange rate is likely to generate an increase in *GSAV* to restore the government balance as per equation 6.9, while *MPS* will decrease to adjust the S-I balance as per equation 6.8.

Figure 7.1 Macro closures for CGE model.



5.3. Closures for factor markets

Factors and closures of the factor markets have been dealt with as described below:

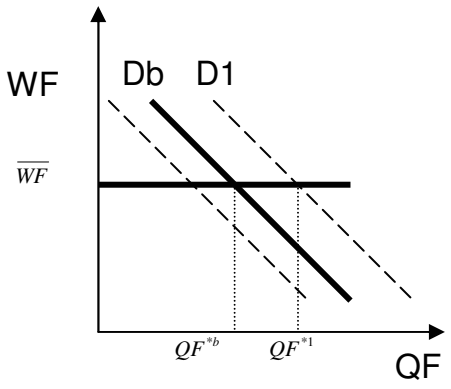
1. Non-agricultural labour has been assumed to be mobile across activities and fully employed. Full employment implies assuming for the simulations the same level of employment as the base case but flexible real wage rates (wages adjust across simulations).
2. For agricultural labour and family labour the full-employment option has been relaxed, thus allowing for unemployment, retaining however the possibility to

move across activities. Given the structure of the model, this implies that the real wage rate has been fixed.

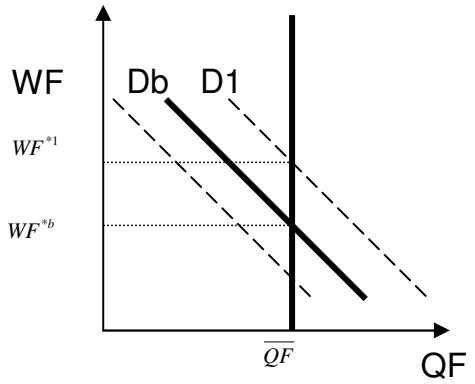
3. Both agricultural capital and non-agricultural capital have been assumed to be fully employed, but, agricultural capital has been assumed to be mobile across activities within the agricultural sector, while non-agricultural capital has been assumed to be activity-specific.
4. Agricultural and non agricultural factor markets are segmented, i.e. agricultural labour, family labour and agricultural capital employed in the agricultural sector at the benchmark, do not move outside the agricultural sector, as much as non-agricultural labour and non-agricultural capital do not move outside the non-agricultural sector.

These assumptions look quite plausible for Burkina Faso, which is characterized both by labour unemployment and underemployment, as well as lack of capital in many sectors. In addition, the agricultural sector does not look interesting enough to attract capital from the non-agricultural sector. However, the assumption that the agricultural and family labour cannot be employed outside the agricultural sector is quite restrictive. It rests on the implicit hypothesis that non-agricultural activities require a different type of labour (different professional profiles with different skills) with respect to agricultural ones. This also implies assuming that the time-span considered for the simulation scenarios to develop is not enough to permit the re-training or the institutional context is not conducive to that end. Agricultural wages, as well as figurative family wages are assumed to be constant as they are assumed to be quite close to the "subsistence" level but unlikely to rise given the relatively high unemployment rate. Figure 7.2 illustrates the assumptions made for the different factor markets. Note that, on the one hand, for the agricultural and family labour, shifts of the demand schedule under different scenarios lead to shifts in the quantity of labour actually employed at a fixed wage rate. This implies that the agricultural and family labour actually provided is demand-led, in the sense that the supply adjusts to factor demand, i.e. labour is available in any quantity at the given market wage. On the other hand, for non-agricultural labour and capital, which are in fixed supply, shifts of the demand schedule lead to shifts in the factor wage.

Figure 7.2 Closures for factor markets



Panel A: Agricultural and family labour



Panel B: Non-agricultural labour and Agricultural – non agric. capital

Db and D1 refer respectively to the factor demand schedule at the benchmark and under an alternative simulation scenario.

The macro-closures adopted result from a mix of features of the macro closures described in section 4. More specifically, they reflect a "neo-classical" closure regarding the non-agricultural labour and capital (full-employment of factors), a "Keynesian" closure regarding the agricultural and family labour (exogenous wage, unemployment, exogenous investment) and a "Johansen closure", (exogenous real investment *QINV* and endogenous government savings *GSAV)*. However, regarding the saving-investment balance, the difference with Johansen's is that here, the saving-investment balance is not achieved through endogenous government savings determined by flexible income tax rates and fixed propensities to save, but by endogenous government savings determined by other tax sources (*OTHIG*) with fixed income tax rates (*TINS*) as well as by shifts in the average propensity to save MPS. In addition, given that different types of households exhibiting different propensities to save are modelled, income distribution changes reflect on the overall savings of institutions. This reflect to a good extent a feature of the Post-Keynesian models (Kaldor-Pasinetti).

As suggested by Lofgren, Robinson et al. (2002), fixed foreign savings (figure 7.1, closure 2.a), fixed real investment (closures 3.a or 3.b) and fixed real government consumption (any of the closures for the government balance), better allow to highlight the total negative (positive) welfare impacts of external shocks or policies on households, as they would not be partially offset (amplified) by decreases (increases) in real investment, real government consumption and increases (decreases) in foreign savings, i.e. injections (drains) of resources from the S-I account, the government account or from the RoW. Note however that welfare effects measured with indicators based on expenditure, such as the Equivalent Variation (*EV*), may be affected by significant changes in the propensities to save *MPS*, as described in the

previous paragraph. For example, a downward shift in the MPS, other things equal, allows the households consuming more or reducing consumption less than what would happen if MPS was kept constant. Therefore, the inspection of shifts in real income is also required to get a full picture of welfare changes. In addition testing alternative macro closures is also advisable. Section 7.3. reports the results of some alternative macro closures.

6. Simulations of socio-economic impacts of external shocks

On the basis of the observed changes in import-export prices in the last twelve years, the price changes reported in table 5 have been retained for simulations. Simulations of external shocks have been carried out and compared with the base case.

Table 5: Price changes by commodity for simulations of external shocks with the CGE model

	Food	Oil/oil products	Fetilizers	Cotton
Average index 1997-2004	85.3	118.9	90.0	80.5
Average index 2005-2008	80.5	240.8	138.7	54.4
Index 2008	93.5	292.3	208.4	54.3
% change 05-08/97-04	**-5.6%**	**102.6%**	**54.2%**	**-32.4%**
% change 08/97-04	**9.6%**	**146.0%**	**131.7%**	**-32.6%**

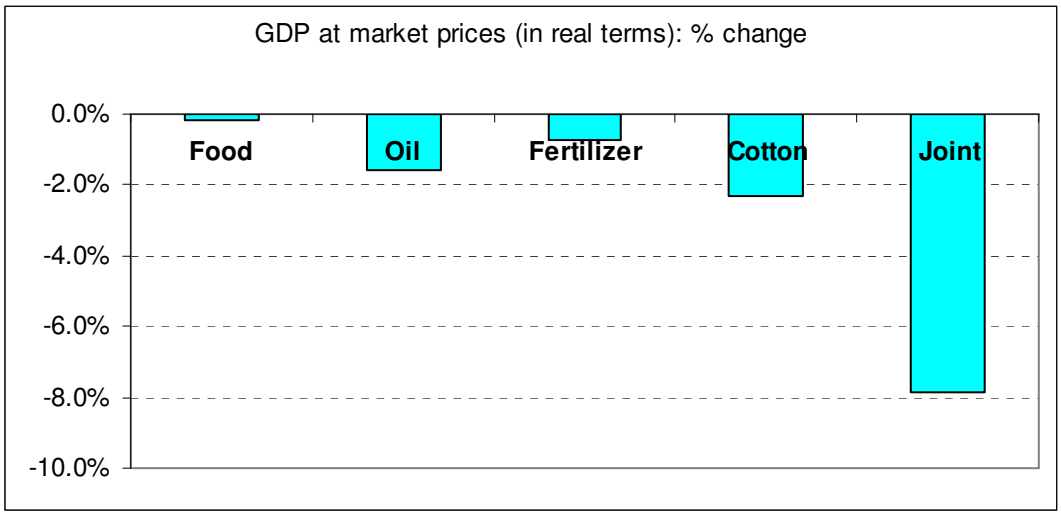
The focus will be put on the change registered in 2008 with respect to the average index of the periods 1997-2004.

6.1. Macro economic impacts

All the four exogenous shocks considered have negative effects on GDP, as reported in figure 7.3[202].

[202] . GDP data reported here are in "real" terms, i.e. new quantities calculated in different scenarios are evaluated at "base" prices. Data in tabular format are reported in the appendix.

Figure 7.3 GDP at market prices (at constant prices, % changes)



Source: CGE model results.

Table 6. Macro-economic impacts of external price shocks (at constant prices)

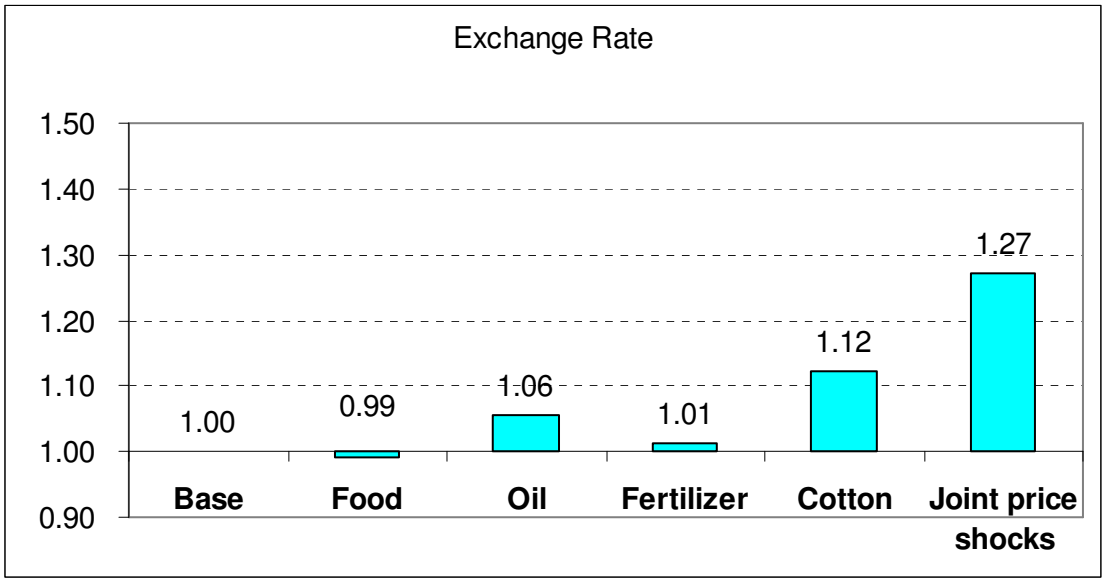
		Base	Food	Oil	Fertilizer	Cotton	Joint shocks
		Million FCFA	*% variation w.r.t.the base*				
a=b+c+d	**Total Absorbption**	**2,119,964**	**-0.4%**	**-6.6%**	**-1.6%**	**-2.3%**	**-12.9%**
b	Private consumption	1,441,816	-0.6%	-9.8%	-2.4%	-3.4%	-19.0%
c	Investment	279,655	0.0%	0.0%	0.0%	0.0%	0.0%
d	Government cons.	398,493	0.0%	0.0%	0.0%	0.0%	0.0%
e	Exports	149,849	-1.5%	32.3%	3.9%	-29.7%	-11.4%
f	Imports	458,157	-1.7%	-13.8%	-3.2%	-11.0%	-32.7%
g=e-f	Trade balance	- 308,308	-1.8%	-36.2%	-6.6%	-1.9%	-43.0%
g=a+g	**GDP at market prices**	**1,811,656**	**-0.2%**	**-1.6%**	**-0.8%**	**-2.3%**	**-7.8%**

Source: CGE model results.

However, while the food shock has marginal impacts (around - 0.2 % of GDP) and fertiliser shows a moderate impact (-0.8%), the price shocks on oil and cotton have significant impacts (around 2% each). When considered jointly, the four price shocks show a very strong impact on GDP, of almost 8%. For the "Joint" scenario, table 6 (rows b, e and f) show that private consumption falls more proportionally than GDP, at around 20%, due to a significant contraction of imports. It also happens to exports.

Shifts in prices of imports and exports change the prices of internationally traded commodities compared to domestically produced substitutes, impacting on the balance of trade. Given that in chosen macro-economic closure for the Rest-Of-the-World account the foreign savings (*FSAV*) are kept constant in real terms (in foreign currency), for all the four external shocks the balance of trade is adjusted by means of a devaluation of the (real) Exchange Rate (*EXR*); expressed as the amount of local currency at constant (base) consumer prices required to buy one unit of foreign currency. As reported in figure 7.4, significant depreciation of local currency occurs due to oil price increase (6%) and cotton price decrease (12%) in order to avoid increasing the external deficit. The joint impact of external shocks amounts to a depreciation of 27% on the local currency.

Figure 7.4 Local currency devaluation (Real Exchange Rate: local currency at constant base consumer prices per unit of foreign currency)



Source: CGE model results

Given the fixed nominal exchange regime of the Franc CFA with respect to the Euro, the real exchange rate has to adjust via adjustments in the ratio of the international versus domestic prices. A depreciation of the real exchange rate of 27% can also be read as a reduction of the level of domestic prices relative to the international prices of around 20% (i.e. 1/1.27)[203], implying a generalized reduction of domestic purchasing power with respect to foreign goods and assets (see the appendix for a detailed explanation of the adjustment of the real exchange rate).

As expected, oil and fertilizer price increases (simulations 2 and 3), leading to upward shifts of the real exchange rate, increase export quantities and decrease imports (table 6, rows e and f) in order to re-equilibrate the external balance. The international food price increase instead (simulation 1), leads to a substitution of imported food with domestic products, entailing the substitution of export crops with food crops which implies a reduction of both exports and imports. Also the fall of the price of cotton, lads to a reduction of both exports and imports although here the magnitude of the reduction is much higher.

Fixing investment in real terms (row c of table 6), implies assuming that the economic system does not slow down the process of capital formation in response to external shocks. However, this implies also that the investment bill shifts in nominal terms, i.e. by means of shifts in relative prices. Indeed, relative prices, as well as the other endogenous components in the left-hand side of the S-I balance (equation 6.8), adjust to the exogenous investment quantities.

[203] This may happen in practice by means of open market operations by the central bank to absorb domestic money. The absorption can be generated by sales of foreign currency against domestic currency. The reduced money supply entails a reduction of the general level of domestic prices. See section 13.4 for a detailed explanation of implications of real exchange rate adjustments under a fixed nominal exchange rate regime.

In particular, the rise of the exchange rate for the oil, fertilizer, cotton and joint price simulations, increases the value in domestic currency of foreign savings. This implies that, being the investment fixed in real terms, the endogenous components of the S-I balance have to adjust downward to satisfy the balance. The burden of the adjustment is born by the private savings which shrink for a reduction of the income of the institutions *YI* (see table 7), associated to a reduction of the propensity to save *MPS*, as reported in table 8.

Table 7. Income of different household groups.

	Base	Food	Oil	Fertilizer	Cotton	Joint
Rural poor	271,356	-0.5%	-6.4%	-2.3%	-3.6%	-16.9%
Rural non-poor	793,400	-0.6%	-12.3%	-3.1%	-5.2%	-26.2%
Urban poor	25,357	-0.7%	-13.3%	-3.0%	-5.2%	-26.9%
Urban non-poor	657,493	-0.8%	-16.0%	-3.3%	-5.6%	-30.4%

Source: CGE model results

Table 8. Average propensity to save of selected non-governmental institutions

	Base	Food	Oil	Fertilizer	Cotton	Joint price shocks
Rural poor	3.7%	3.7%	3.2%	3.5%	3.2%	1.6%
Rural non-poor	5.1%	5.1%	4.5%	4.9%	4.5%	2.2%
Urban poor	9.2%	9.2%	8.0%	8.8%	8.0%	4.0%
Urban non-poor	21.1%	21.1%	18.3%	20.0%	18.4%	9.1%

Source: CGE model results

One would expect that the increase in the domestic value of foreign savings reduce the government savings *GSAV*. However, no room for downward adjustments of *GSAV* is left, as the currency devaluation increases also the amount of foreign transfers to government in local currency (table 9, first row). Given the importance of foreign transfers in the government balance (they amount to almost 45% of the government income), this countervails the reduction of income taxes. This leads, together with increases in the export and import taxes to an increase of *GSAV* (reduces the deficit, table 8, last row). Note that the increase of *GSAV*, is also supported by a reduction of the government expenditure for consumption (the expenditure for services to households reduces by slightly less than 22% in the joint price change simulation). This decrease is due to a reduction in the relative prices of the two service commodities purchased by the government, as the government consumption is fixed in real terms (see the table A1 on price changes, in appendix).

Table 9. Government budget (% variation w.r.t. the base, unless otherwise stated)

	Base	Food	Oil	Fertilizer	Cotton	Joint
Transfers from ROW	160,368	-0.9%	5.5%	1.3%	12.3%	27.2%
Income taxes	61,345	-0.7%	-16.0%	-3.4%	-5.7%	-30.9%
Import taxes	37,890	-1.8%	43.7%	2.4%	0.6%	52.9%
Export taxes	276	-1.7%	9.2%	2.2%	22.9%	50.6%
Taxes on activities	3,611	0.1%	-10.5%	-3.0%	-2.8%	-20.2%
Taxes on commodities	99,737	-0.6%	-7.9%	-2.1%	0.2%	-12.8%
Total gov.t income (var %)	363,228	-0.9%	2.0%	-0.3%	4.6%	8.6%
Total gov.t income (M.Fcfa)	**363,228**	**360,028**	**370,547**	**362,030**	**379,755**	**394,586**
Services to enterprises	10,372	-0.9%	-16.0%	-3.4%	-4.7%	-30.2%
Services to households	388,121	-0.9%	-9.0%	-3.0%	-5.5%	-21.7%
Transfers to households	46,305	0.0%	0.0%	0.0%	0.0%	0.0%
Total govt. expenditure (var %)	444,798	-0.8%	-8.2%	-2.7%	-4.9%	-19.6%
Total expenditure (M.Fcfa)	**444,798**	**441,177**	**408,330**	**432,944**	**422,822**	**357,461**
Gov. savings var %(+/-)	- 81,570	-0.5%	-53.7%	-13.1%	-47.2%	-145.5%
Gov. savings (+/-) M.Fcfa	**- 81,570**	**- 81,149**	**- 37,782**	**- 70,914**	**- 43,067**	**37,125**

Source: CGE model results

6.2. Activity levels

The level of the different activities shifts under the various simulation scenarios (figure 7.5). International food price shocks slightly stimulate domestic agriculture, due to partial substitution of imported food with domestic produces, as well as domestic agro-industry. As the resource base (notably land and agricultural capital) constitutes a binding constraint, non food agriculture, specifically cotton grain and related cotton ginning activities, shrink (figure 7.5, simulation "Food".

Oil price shocks have strong impacts on the import bill, due to the negligible possibilities to substitute imports with domestic energy products. This leads to a pressure on the balance of trade. However, under this scenario, the deficit of the balance of trade is exogenously fixed, therefore the adjustment on the foreign currency market occurs via an upward shift of the real exchange rate (see figure 7.4). This in turn leads to an increase of the exports of cotton, (+ 56%, figure 9, "Oil" simulation) which become more competitive. However this implies a diversion of the constrained resources (land and capital) from the other agricultural activities, generating a quite significant reduction of all the other agricultural and agro-industrial activities of -9% and -4% respectively. In spite of the significant increase of the cost of energy, largely used in the industrial sector, the upward shift of the exchange rate leads also to a 3% increase of the other industrial activities. This is due to import substitution of imported industrial items with domestically produced ones.

The price shock of fertilizers (figure 7.5, simulation "Fertilizers") leads to quite similar impacts as the oil price shock, although their magnitude is less important. In spite of the fact that the cotton activity is one of the largest consumers of fertilizer, its activity level increases (+6.7%), due to the pressure on the external balance of trade, as cotton is also the largest export commodity. This in turn, leads to a reallocation of agricultural factors towards the cotton activity, leading to a reduction of all the other agricultural activities as well as the associated agro-industrial activities.

Regarding the impacts of the shrinking international cotton prices, as expected, this leads to a very large contraction of the cotton grain production and ginning activities (almost -70%, figure 7.5, simulation "Cotton"). The significant depreciation of the real exchange rate makes more competitive domestic industrial products vis à vis imported ones, thus leading to an increase of the activity level of the industrial sectors (+8).

When all the price shocks are jointly considered, the reduction of the cotton activity due to the reduction of cotton prices is only partially compensated by the stimulus received by the cotton sector due to the increased demand of foreign currency associated to the oil price rise. This leads to a substantial decrease of the cotton activity (around -60%), an overall contraction of agricultural activities (-18%) and livestock (-9%), justified by the downturn of the whole economic system, as well as to a significant increase of the industrial activities, due to import substitution.

While the separated impacts of shocks on the imports side (oil) and on the export side (cotton) do not generate substantial shrinking of the whole economic activity, the joint impacts international shocks generate a general slow down of all the economic activities (excluded the industrial ones which, however, account for less that 10% of the total output of the system).

Figure 7.5 Activity levels (percent changes w.r.t. the base)

	Food	Oil	Fertilizer	Cotton	Joint
Cotton grains+ginning	-2.6%	55.7%	6.7%	-68.7%	-59.4%
Other agriculture	0.4%	-9.0%	-5.9%	-1.0%	-17.6%
Livestock, forestry, fishing	-0.2%	-4.3%	-0.9%	-0.5%	-8.9%
Other agroindustry	0.9%	-2.9%	-1.0%	0.5%	-4.5%
Other Industry	-0.1%	3.3%	1.7%	8.3%	24.6%
Services	0.0%	-1.1%	-0.1%	-0.2%	-2.1%

Source: CGE model results. Aggregated activity levels measured at base prices. Detailed activity levels are reported in appendix.

Downward turns in most activity levels affect the effective demand of factors.

Table 10. Factor demands

	Base	Food	Oil	Fertilizer	Cotton	Joint
Agricultutral labour	14,355	-0.4%	0.7%	-3.0%	-12.0%	-24.8%
Non-agricultural labour	308,282	0.0%	0.0%	0.0%	0.0%	0.0%
Family labour	301,027	-0.3%	-2.9%	-3.5%	-8.6%	-23.5%
Agricultural capital	169,155	0.0%	0.0%	0.0%	0.0%	0.0%
Non-agricultural capital	877,322	0.0%	0.0%	0.0%	0.0%	0.0%

Source: CGE model results.

6.3. Welfare impacts

The relative shift of one activity with respect to the others, as well as the general downturn of the whole economic activities have significant impacts on the income generation and distribution, as well as on relative prices of final consumption goods and services. Income and price variations, in turn, affect the level of welfare of the various layers of the population.

In order to highlight the distributional effects of the external shocks, an analysis of the Equivalent Variation (*EV*) of the expenditure for different household groups was carried out.

The Equivalent Variation (EV) of household expenditure, by type of household, is:

$$EV_h = \left(TotExp_{h,1} - SubsExp_{h,1}\right)\left(\frac{P_0}{P_1}\right) - \left(TotExp_{h,0} - SubsExp_{h,0}\right)$$

where h is the index of the type of household, *0* and *1* are respectively the indexes referring to the benchmark case and the shock/policy scenario, $TotExp_{h,1}$ and $TotExp_{h,0}$ are respectively the total expenditure of the household for final consumption under the shock/policy scenario and in the benchmark case, $SubsExp_{h,1}$ and $SubsExp_{h,0}$ are the "subsistence" expenditures of the household, i.e. the minimum consumption required for survival, P_1 and P_0 are price indexes built as geometric means of prices using consumption shares of the different consumption goods as powers of prices [204]. Therefore, the EV is the difference between the "supernumerary" expenditure of each type of household, i.e. the expenditure in excess over the subsistence expenditure, in the policy scenario, and the supernumerary expenditure at the benchmark,; both expressed in monetary terms at the benchmark price level. In addition, the total EV is the sum of the EV across the household types.

[204] The EV can be interpreted as the variation of income of the household equivalent to the shock/policy change. More specifically, it is the minimum amount that the households are ready to accept as compensation if the policy change does not occur, in case of EV positive, (also referred to as minimum Willingness To Accept - min WTA) or the maximum amount that the households would be willing to give up to avoid the shock/policy change, in case of EV negative (referred also as maximum Willingness To Pay – max WTP to avoid the change). The model adopts formulas for CV and EV reported in: Blonigen, Bruce A., Joseph E. Flynn, and Kenneth A. Reinert (1997): Sector-Focused General Equilibrium Modelling, pp. 189-230 in eds. Joseph F. Francois and Kenneth A. Reinert, Applied Methods for Trade Policy Analysis. Cambridge, MA: Cambridge University Press.

A percentage indicator *EVP* will also be worked out to compare the EV with the base total expenditure. Calling the "supernumerary" expenditure $SupExp_h = TotExp_h - SubsExp_h$ and dividing the EV by the total expenditure at the benchmark, the *EVP* results:

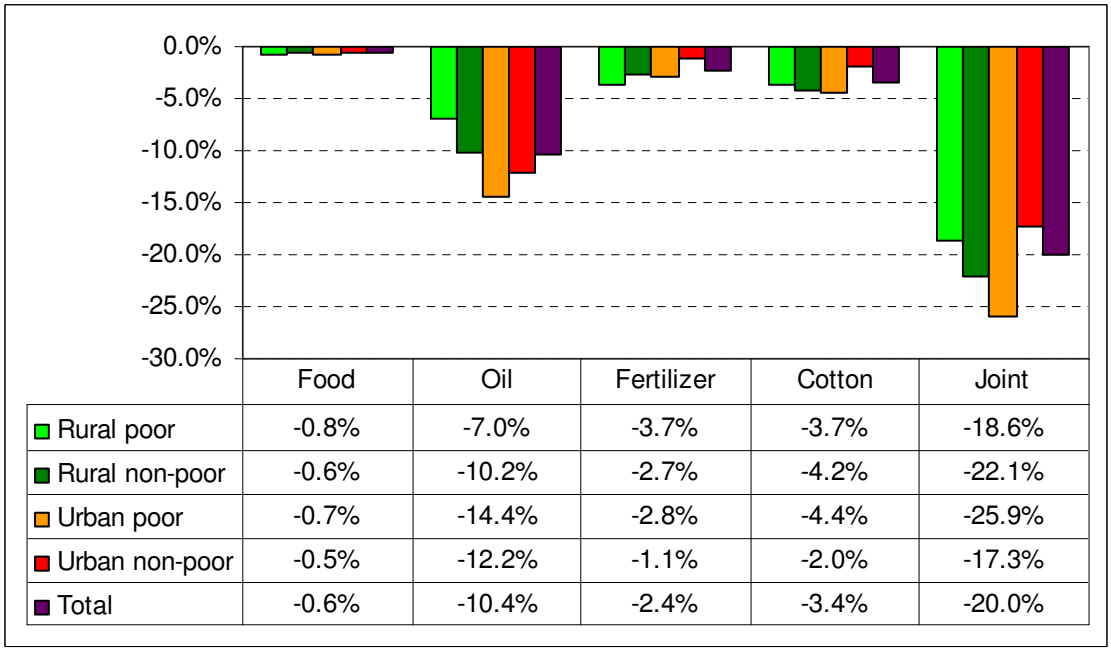
$$EVP_h = \frac{SupExp_{h,1}\left(\frac{P_0}{P_1}\right) - SupExp_{h,0}}{TotExp_{h,0}}$$

To ease the direct comparison of the income changes of households with the base case, the Consumer Price Index (CPI) has been chosen as the numeraire of the system.

Results of the EV under different scenarios are reported in figure 7.6[205].

As expected, all the shocks have negative welfare impacts on all the household groups. However, note that the impacts of the different shocks do not only differ in magnitude, but also on distributional grounds.

Figure 7.6 Impacts of price shocks on welfare (EV) of different household groups.



	Food	Oil	Fertilizer	Cotton	Joint
Rural poor	-0.8%	-7.0%	-3.7%	-3.7%	-18.6%
Rural non-poor	-0.6%	-10.2%	-2.7%	-4.2%	-22.1%
Urban poor	-0.7%	-14.4%	-2.8%	-4.4%	-25.9%
Urban non-poor	-0.5%	-12.2%	-1.1%	-2.0%	-17.3%
Total	-0.6%	-10.4%	-2.4%	-3.4%	-20.0%

Source: CGE model results

While the shift in the international price of food items affects household welfare only marginally, oil price increases have a very strong impact on the welfare of all household categories (-10.4%) with negative impacts ranging from 7% to more than

[205] Detailed tables are reported in appendix.

14% respectively for rural and urban poor. This diversification in the magnitude of welfare impacts across the households depends on:

1. **Factor income variations**: the different income sources of the different household groups. Total non-agricultural wages fall more than agricultural wages and remuneration of family work (15.8%, 0.73% and 2.88/%, respectively) thus affecting more significantly the urban segment of the population (table 11)[206]. Analogously, rents of non-agricultural capital also shrink more than rents of agricultural capital;
2. **Domestic price changes and expenditure allocation.** Under the simulation with international oil price shift, the domestic price of energy products increases by around 116%. (see table A2 in appendix). In addition, table 4 shows different expenditure shares across household groups on energy (oil) intensive items: urban poor allocate more expenditure on energy products and transport than rural poor (9% and 1.9% against 6.7% and 1.4% respectively).

Table 11. Factor income by type of factor (FCFA for the base, and %change)

	Base	Food	Oil	Fertilizer	Cotton	Joint
Agricultural labour	14,355	-0.39%	0.73%	-3.00%	-11.95%	-24.80%
Non-agricultural labour	308,282	-0.89%	-15.83%	-3.20%	-6.93%	-32.41%
Family labour	301,027	-0.31%	-2.88%	-3.49%	-8.63%	-23.50%
Agricultural capital	169,155	-0.55%	-8.98%	-2.00%	-1.27%	-16.59%
Non-agricultural capital	877,322	-0.78%	-20.04%	-4.19%	-6.89%	-37.61%

Source: CGE model results

Regarding the shock on fertiliser's price, the magnitude of its impacts on welfare is lower than that of oil, affecting overall household expenditure by -2.4%. Nevertheless, it is not negligible, as it ranges from 1.1% for urban non-poor households to 3.7% for rural poor ones, shown to be particularly adverse to this layer of the population. Again, this can be explained by:

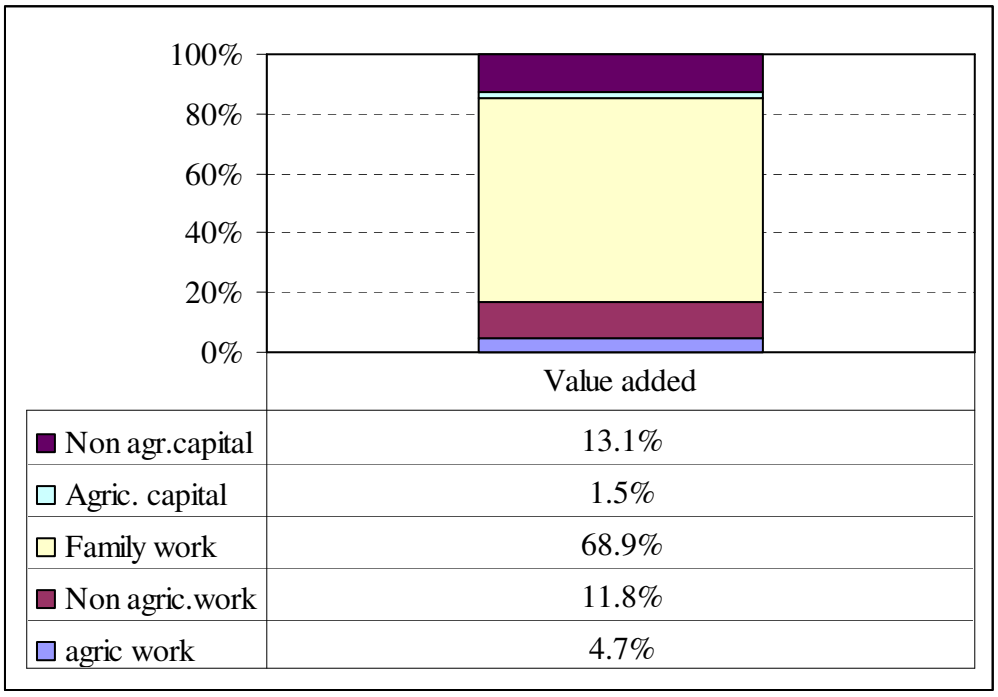
1. **Factor income variations**: the inspection of factor income variations highlights a negative impact (-3.5%) on family labour, by far the most used factor in agriculture.
2. **Domestic price changes and expenditure allocation**: the analysis of domestic price changes highlights that domestic prices of agricultural goods, and in particular, food crops and vegetables are more affected than other goods, with price increases ranging between 6.5% and 11% (see table A2). In addition, as reported in table 4, the expenditure of rural (and urban) poor concentrates on these items (44% and 30% respectively) proportionally more than the expenditure of rural and urban non-poor (25% and 16% respectively). That is why welfare impacts of the fertiliser's price increase are stronger on the poor layers of the population.

The welfare impact of the shock on cotton export price is stronger in magnitude than the shock on fertilisers (-3.4% overall). This affects in particular rural people and urban poor people. This impact can be explained considering the sharp reduction in the activity levels in the cotton value chain. Both primary production and ginning, other things being equal, shrink at around 70% (see table A4 in appendix). As shown

[206] Note that the factor income is the product of the quantity of each factor absorbed times the specific factor wage.

in figure 7.7, the cotton value chain makes wide use of family labour (more than 67% of the value added is allocated to remunerate this factor) and to a lesser extent of non agricultural capital[207]. It is mainly through these factor channels that the reduction in the cotton value chain output affects welfare.

Figure 7.7 Value added repartition in the cotton value chain (% of total value added)



Non agr.capital	13.1%
Agric. capital	1.5%
Family work	68.9%
Non agric.work	11.8%
agric work	4.7%

Source: SAM year 2000 Burkina Faso

The joint welfare effects of the different international price shocks amount to -20%, affecting in particular urban poor (-25.9%) and rural segments (-22.1% rural non-poor and 18.6% rural poor population). The rural poor households are shown to be, to some extent, more resilient to external shocks than urban poor ones, probably due to their lower degree of integration with the economic system, in particular through the energy sector, and the possibility of adjusting their income sources by shifting their cropping patterns to some extent.

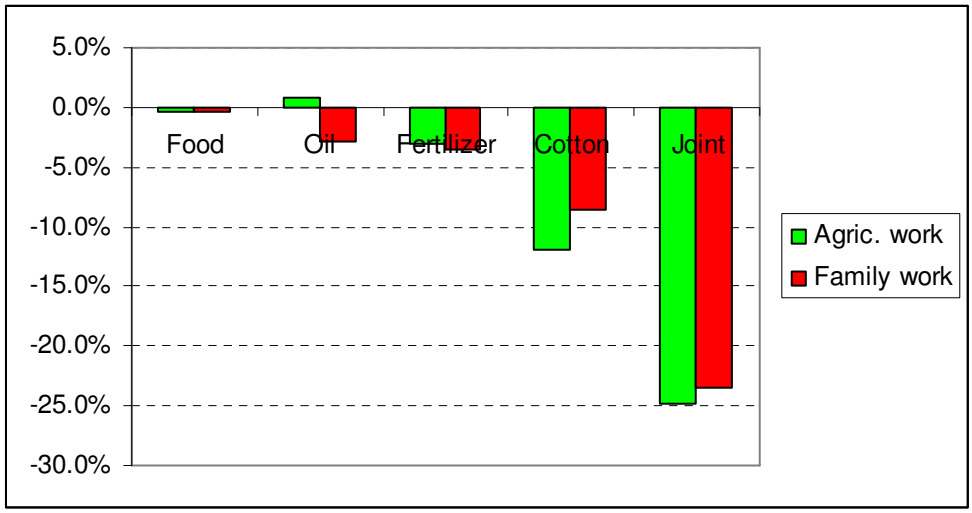
Beyond price, income and expenditure impacts, all directly affecting the welfare of households, it is important to look at the way international price shocks affect factor uses. Figure 7.8 reports shifts in the use of agricultural (wage) work and family work[208]. Note that all the price shocks have negative impacts on employment, particularly strong for fertiliser and cotton price shocks. The joint effect amounts to a

[207] The larger impact on urban poor could be due to the fact that more than 50% of their income is represented by the remuneration of non-agricultural capital services (micro-enterprise, self employed income).

[208] Note that agricultural (wage) work and family labour are the only factors assumed to be flexible, i.e. showing unemployment at the base case. The assumptions of full employment of non-agricultural work, agricultural and non agricultural capital imply no changes in the use of these factors.

loss of around 25% of job units for these factors, generating significant further unemployment in a context already characterised by few job opportunities.

Figure 7.8 Factor use (% changes) under different international price shocks scenarios.



Source: CGE model results

The analysis of international price shocks reported above highlights the importance of decoupling income generating activities, specifically of the poorer layers of the population, from international price fluctuations, in particular energy and fertilisers. This implies, among other things, the adoption of policy measures favouring less energy intensive technologies and the exploitation of comparative advantages in domestic energy and fertiliser production.

6.4. Alternative macro-economic and factor-market closures

The above-reported macro closures (i.e. flexible government savings with fixed real government consumption, flexible exchange rate, and fixed investment in real terms), associated to unemployment of agricultural and family labour, have been chosen with the aim of highlighting the welfare impacts of external shocks. Under these assumptions, the economic system adjusts to following this likely path:

1. Shifts of international prices (expressed in foreign currency) *PWE* and *PWM* alter the external balance.
2. Imported and exported quantities *QE* and *QM* have to adjust. Changes of relative prices of exported and imported goods respectively : *PE/PD* and *PM/PD* occur due to shifts of the exchange rate *EXR* which alter *PE=PWE*EXR and PM=PWM*EXR*.
3. *QD/QM* and *QD/QE* adjust and shift activity levels and factor demands *QF* or wages.
4. Factor income *YF=WF*QF* adjusts via changes of *QF* (for agricultural and family labour) or *WF* (for non-agricultural labour and capital).
5. Household income *Y* adjusts via changes of factor income, leading to changes in household demands.
6. *EXR* shifts both *FSAV* in S-I and *FTRANSF* in government balance account and, as a consequence, the government savings *GSAV* adjust.

7. *MPS* adjusts to restore the S-I balance and the domestic prices *PQ* further adjust.
8. The other government income *OTHIG* adjusts to satisfy the government balance.

An alternative closure for the family-labour market has been also tested, associated to an alternative closure of the Savings-Investment balance. The following assumptions have been chosen as alternative closure rules:

1. The Family labour wage *WF* is made flexible (keeping flexible also the supply of labour);
2. The propensity to save *MPS* is fixed (see the modified S-I balance, equation 6.8a below).

This closure mimics a "Keynesian"-type closure, where external shocks, affecting the saving-investment balance, are absorbed by a passive adaptation of savings not generated by adjustments of the propensities to save but by changes in output and incomes.

Note that it is assumed that the agricultural and family labour market is demand-led, in the sense that the supply adjusts to factor demand. This implies that labour is available in any quantity at the prevailing market wage. However, the prevailing market wage, for any quantity of labour, still corresponds to the marginal value product of the specific quantity of labour employed. This is assured by the fact that any equilibrium point, i.e. any combination of wage-quantity lies on the factor demand schedule.

Changing assumptions regarding the way factor markets work and the way savings adjust to exogenous investment shifts is likely to alter the transmission mechanism through which shifts in international prices reflect on the economic system.

Under this closure the economic system is likely to adjust to following this path:
1. Shifts of international prices (expressed in foreign currency) *PWE* and *PWM* alter the external balance.
2. Imported and exported quantities *QE* and *QM* have to adjust. Changes of relative prices of exported and imported goods respectively : *PE/PD* and *PM/PD* occur due to shifts of the exchange rate *EXR* which alter *PE=PWE*EXR* and *PM=PWM*EXR*.
3. *QD/QM* and *QD/QE* adjust and shift activity levels and factor demands *QF* or wages.
4. Factor income *YF=WF*QF* adjusts via changes of BOTH *QF* AND *WF*. The possibility to lower *WF* enables the entrepreneurs to hire more labour with respect to the case where *WF* is fixed.
5. Household income *Y* adjusts via changes of factor income, leading to changes in household demands.
6. *EXR* shifts both *FSAV* in S-I and *FTRANSF* in government balance account and, as a consequence, the government savings *GSAV* adjust.
7. MPS is fixed, so the Saving–Investment balance (S-I) is restored through changes of income *YI*.
8. The other government income *OTHIG* adjusts to satisfy the government balance.

As a further alternative, it is of interest testing a "minimum-wage" or "Lower-bounded" labour wage closure. This implies imposing a lower bound on the family labour wage in order to ensure that the wage does not fall below a given "subsistence" level for rural households. Negative external shocks reduce the level of domestic prices with respect to foreign ones. Producers reduce their production costs by lowering the remuneration of factors, including labour. When the family-labour wage reaches the lower bound, other variables in the system have to bear the cost of the adjustment. A simulation is run where foreign transfers to the government, which were modelled as exogenous in the other simulations, are endogenized. Adjustments of foreign transfers would allow the system to fill the competitiveness gap generated when the wage is not allowed to reduce below its lower bound.

To endogenize the foreign transfers when the lower bound for the family labour wage is reached, an endogenous multiplier of the base foreign transfers (variable *LAMBDA*) was created. This implies allowing for a conditional "solve statement" in the solution of the model, where the equation fixing the wage level at its lower bound operates only if this lower bound is actually binding under the new equilibrium. When this occurs the equation fixing the wage at its lower bound replaces the equation fixing the multiplier of foreign transfers (variable *LAMBDA*) at its benchmark value (say, the unity). The macro-economic closures after this modification result as follows:

External balance:

$$QE \cdot \overline{PWE} - QM \cdot \overline{PWM} = \overline{tr(ROW, F)} - \overline{tr(F,ROW)} - LAMBDA \cdot \overline{FTRANSF} - \overline{FSAV} \quad (6.7a)$$

S-I balance:

$$YI \cdot (1 - \overline{TINS}) \cdot \overline{MPS} + GSAV + \overline{FSAV} \cdot EXR = \overline{QINV} \cdot PQ \quad (6.8a)$$

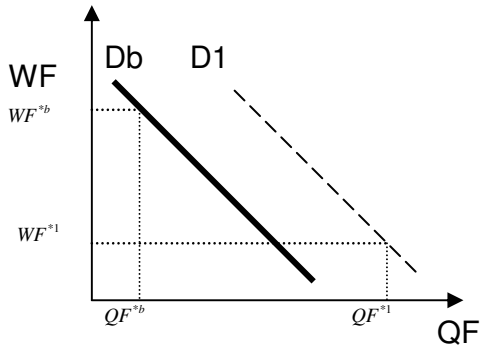
Government balance:

$$\overline{TINS} \cdot YI + LAMBDA \cdot \overline{FTRANSF} * EXR + OTHIG = \overline{QG} \cdot PQ + \overline{Transf} \cdot CPI + GSAV \quad (6.9a)$$

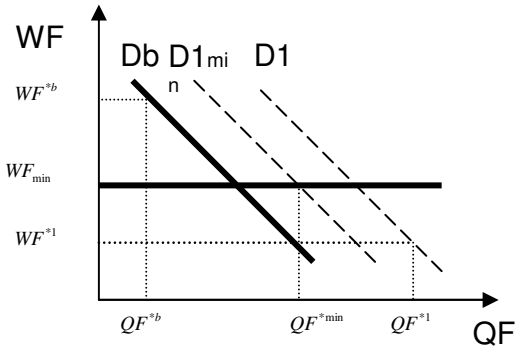
Note that, when *LAMBDA* is endogenized, the trade balance is no longer exogenous, as it occurred under equation (6.7), as the component $LAMBDA \cdot \overline{FTRANSF}$ on the right hand side of equation (6.7a) is simultaneously determined together with the endogenous components of the left hand side of the same equation, say, the quantities *QE* and *QM*. Endogenizing the trade balance (in foreign currency) is expected to have also an impact on the exchange rate, which is no longer the only variable bearing the burden of adjusting the external balance by shifting the ratio of foreign to domestic prices. In addition, impacts on the structure of the government account, specifically on the income side are expected, as $LAMBDA \cdot \overline{FTRANSF}$ enters as an income component on the left hand side of equation (6.9a).

Figure 8.1 represents the assumptions related to of the family labour factor under these alternative closures.

Figure 8.1 Alternative factor closures for the family-labour market.



PANEL A
Endogenous wage (demand-led labour market). MPS is fixed.



PANEL B
Endogenous wage with lower bound.

In figure 8.1, panel A, the endogenous wage *WF* is still determined by its marginal value product (represented as a point along the factor demand schedule) as in the case of figure 7.2, but the actual level of labour supplied and its related wage level is determined by other factors within the economic system, such as the activity levels, the income level required to generate the savings to satisfy the saving-investment balance as well as the government balance. In panel B, a lower bound *WFmin* is imposed. A shift of the labour demand schedule due to exogenous shocks (simulations), in absence of a lower bound on the wage would determine a wage *WF*1* and a quantity demanded. However, in presence of a lower bound, a quantity *WF*min* is determined, corresponding to the wage level *WFmin.* It has to be noted however, that, even in presence of a lower-bounded wage, the equality of the wage level to its marginal value product is still assured, as the lower-bounded equilibrium of the factor market lies on the factor demand schedule *D1min*.

6.5. Simulations under alternative macro-economic and factor-market closures

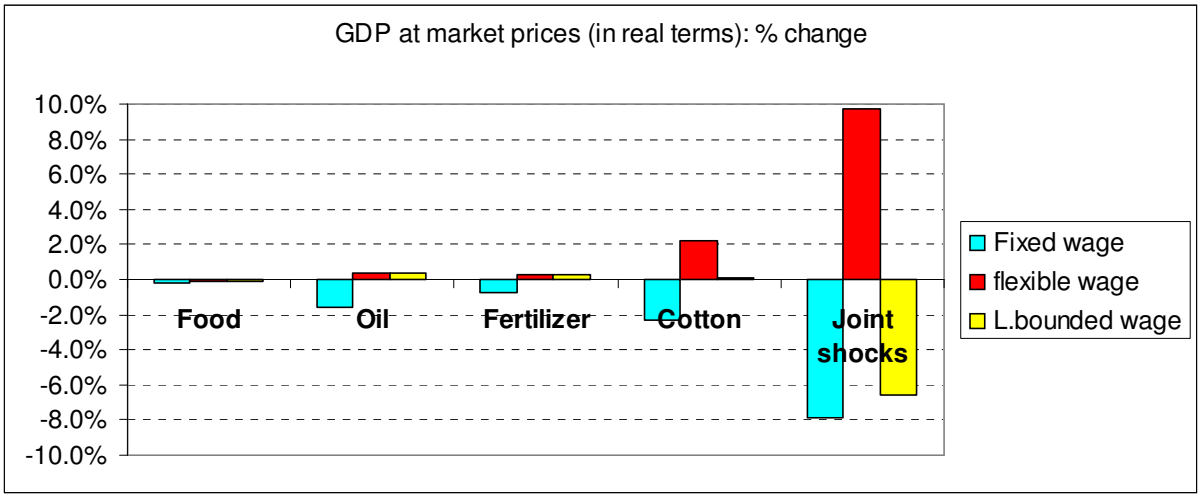
The same international price shocks simulations reported in section 7 were run under the alternative factor market closures illustrated in figure 8.1 panels A and B.

When running the set of simulations with flexible Lower-bounded family labour wage, shocks on prices of food, oil, and fertilizer don't lead reductions of the wage below the lower bound, i.e. the lower bound wage is non-binding. This implies that for these shocks the results obtained imposing a lower-bound to the family-labour wage are the same as the results of the simulations with unbounded flexible wages. For simulations on cotton price and joint prices shocks the lower bound becomes binding. In these cases the wage is set at the lower bound and foreign transfers adjust to achieve the equilibrium of all the markets.

For all the simulated price shocks, the flexibility of family-labour wage allows the system to expand. Figure 8.2 reports the GDP in real terms (at base prices) for the various simulations under the three wage-regimes. While with fixed family-labour

wage GDP substantially shrinks, the opposite occurs with flexible family labour wage. This is particularly evident for the cotton price and the joint price shocks simulations, where the GDP shifts from -2% to +2% and -8% to almost +10% respectively. Under the lower-bounded wage regime the differences with the fixed-wage regime are definitely less important (from -2% to 0.1% and from -8% to -6% for cotton and joint shocks respectively).

Figure 8.2 GDP at constant prices with fixed, flexible and lower bounded family labour wage.



The comparison between the GDP components with fixed wage (table 12 panel A), and the GDP components with flexible wage (table 12 panel B) shows significant differences in the total absorption (row a). While fixed wages lead to important negative changes of the absorption, flexible wages lead to almost zero or positive shifts for most simulations (except the oil price shock which implies a substantial negative change in absorption under both wage regimes). Differences in the changes of total absorption under the two wage regimes are due to important differences in the shifts of the private consumption component, as both the government and investment components are anchored to the base case in real terms (fixed quantities) by assumption (see the macro-economic closure rules above). Under the fixed-wage regime the private consumption (row b) substantially shrinks due to price shocks, down to a -19% for the "joint price" simulation, while under the flexible-wage regime the private consumption remains closer to the base case (except for the oil price simulation) and even increases for the "cotton" and "joint prices" simulations. This difference is due to the fact that with flexible wage, more labour is absorbed by the economic system at a lower cost, allowing to maintain the competitiveness of the system and expanding the GDP even in presence of worsening international prices.

Under the lower-bounded wage regime, for the cotton price simulation, the absorption, as well as the private consumption fall less than under the fixed wage regime. Conversely, for the "joint price" shocks simulation, the absorption falls more than under the fixed wage regime, and the flexible unbounded wage regime (table 12, panel C, row a), negatively affecting private consumption (panel C, row b).

Variations of the GDP at base prices are also due to variations in physical terms of imports and exports. Shocks on import prices (oil and fertilizers) stimulate exports and depress imports. Shocks on export prices (cotton) as well as joint price shocks depress both exports and imports. In all cases these shocks lead to a reduction of the net imports measured at base domestic prices, particularly strong with lower bounded wages for the simulation "Joint price".

Figure 8.2a reports percentage variations of main import and export commodities for the various price shocks under the different wage regimes.

Upward price shocks on imports (food, oil and fertilizers) reduce quantities of imported items and increase quantities of exported items. This is due to the fact that: 1) there is limited substitutability of imported items with domestically produced ones; 2) the trade balance is constrained as the foreign savings are fixed in foreign currency, implying that any increase in the import bill in foreign currency has to be compensated by increases in export incomes. Point 1) above however does not hold for the simulation on food prices as food items exhibit a higher elasticity of substitution with domestically produced food than other commodities. Under this simulation, there is a slight increase of fertilizer imports, due to the expansion of selected domestic agricultural activities producing food items and a slight decrease of the exports of cotton, due to the shifts of factors from the cotton to the food sectors. Downward shifts of imported commodities and upward shifts of exported ones are stronger with flexible wages rather than fixed wages, signaling a greater capacity of the economic system to react to external shocks and restore its relative competitiveness thanks to the possibility to lower wages and inject additional factors to sustain the output.

Table 12. GDP components in real terms (at base prices). Simulations with fixed, flexible and lower-bounded family-labour wage*

A. Fixed family-labour wage

		Base	Food	Oil	Fertilizer	Cotton	Joint shocks
		Million FCFA	*% variation w.r.t.the base*				
a=b+c+d	**Total Absorbption**	**2,119,964**	**-0.4%**	**-6.6%**	**-1.6%**	**-2.3%**	**-12.9%**
b	Private consumption	1,441,816	-0.6%	-9.8%	-2.4%	-3.4%	-19.0%
c	Investment	279,655	0.0%	0.0%	0.0%	0.0%	0.0%
d	Government cons.	398,493	0.0%	0.0%	0.0%	0.0%	0.0%
e	Exports	149,849	-1.5%	32.3%	3.9%	-29.7%	-11.4%
f	Imports	458,157	-1.7%	-13.8%	-3.2%	-11.0%	-32.7%
g=e-f	Trade balance**	- 308,308	1.8%	36.2%	6.6%	1.9%	43.0%
g=a+g	**GDP at market prices**	**1,811,656**	**-0.2%**	**-1.6%**	**-0.8%**	**-2.3%**	**-7.8%**

B. Flexible family-labour wage

		Base	Food	Oil	Fertilizer	Cotton	Joint shocks
		Million FCFA	*% variation w.r.t.the base*				
a=b+c+d	**Total Absorbption**	**2,119,964**	**-0.3%**	**-5.0%**	**-0.8%**	**1.3%**	**0.5%**
b	Private consumption	1,441,816	-0.5%	-7.4%	-1.1%	2.0%	0.7%
c	Investment	279,655	0.0%	0.0%	0.0%	0.0%	0.0%
d	Government cons.	398,493	0.0%	0.0%	0.0%	0.0%	0.0%
e	Exports	149,849	-0.9%	46.3%	11.3%	-10.7%	71.5%
f	Imports	458,157	-1.5%	-9.5%	-0.9%	-6.0%	-13.0%
g=e-f	Trade Balance**	- 308,308	1.8%	36.6%	6.9%	3.6%	54.1%
h=a+g	**GDP at market prices**	**1,811,656**	**-0.1%**	**0.3%**	**0.3%**	**2.2%**	**9.7%**

C. Lower bounded family-labour wage

		Base	Food	Oil	Fertilizer	Cotton	Joint shocks
		Million FCFA	*% variation w.r.t.the base*				
a=b+c+d	**Total Absorbption**	**2,119,964**	**-0.3%**	**-5.0%**	**-0.8%**	**-1.3%**	**-16.3%**
b	Private consumption	1,441,816	-0.5%	-7.4%	-1.1%	-1.9%	-24.0%
c	Investment	279,655	0.0%	0.0%	0.0%	0.0%	0.0%
d	Government cons.	398,493	0.0%	0.0%	0.0%	0.0%	0.0%
e	Exports	149,849	-0.9%	46.3%	11.3%	-14.7%	41.8%
f	Imports	458,157	-1.5%	-9.5%	-0.9%	-10.9%	-35.7%
g=e-f	Trade balance**	- 308,308	1.8%	36.6%	6.9%	9.1%	73.3%
g=a+g	**GDP at market prices**	**1,811,656**	**-0.1%**	**0.3%**	**0.3%**	**0.1%**	**-6.6%**

* Variations of GDP and GDP components are rates of change calculated on the Laspeyres index of physical quantities (volumes) weighted with base prices.
** Variations of the trade balance at domestic base prices (rows g in the tables above) are calculated on the absolute value of the trade balance at the base. This implies that positive variations signal either a reduction of the deficit measured at domestic base prices (as in all the cases above) or an increase of the surplus.

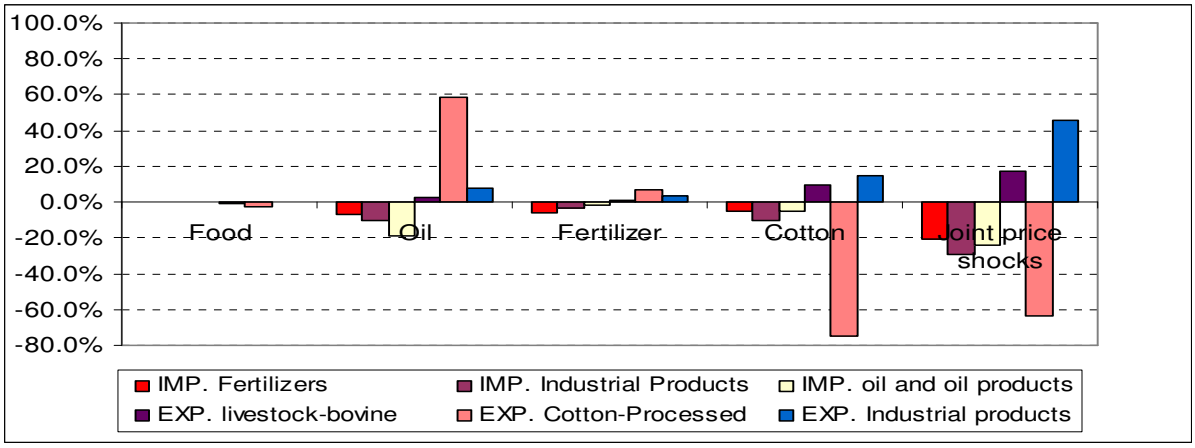
Downward price shocks on exports, (cotton), sharply reduce the export of cotton and, by way of consequence, limit the possibility to import (figure 8.2a, simulations "Cotton"). Conversely, other exports are stimulated, such as the livestock-bovine products and the industrial ones.

When simulating the impact of cotton price reductions under the flexible-wage regime, as in the case of import shocks, the system shows a greater capacity to adsorb the shock than with fixed wages: cotton exports reduce less than in the fixed wage case (-53% with respect to -75% respectively) and the other export sectors expand more, in particular the livestock-bovine sector (+66% with respect to +10% respectively). The sharp expansion of this sector pulls also up the imports of fertilizers (+16%), which showed a negative sign (-5%) under the fixed wage regime.

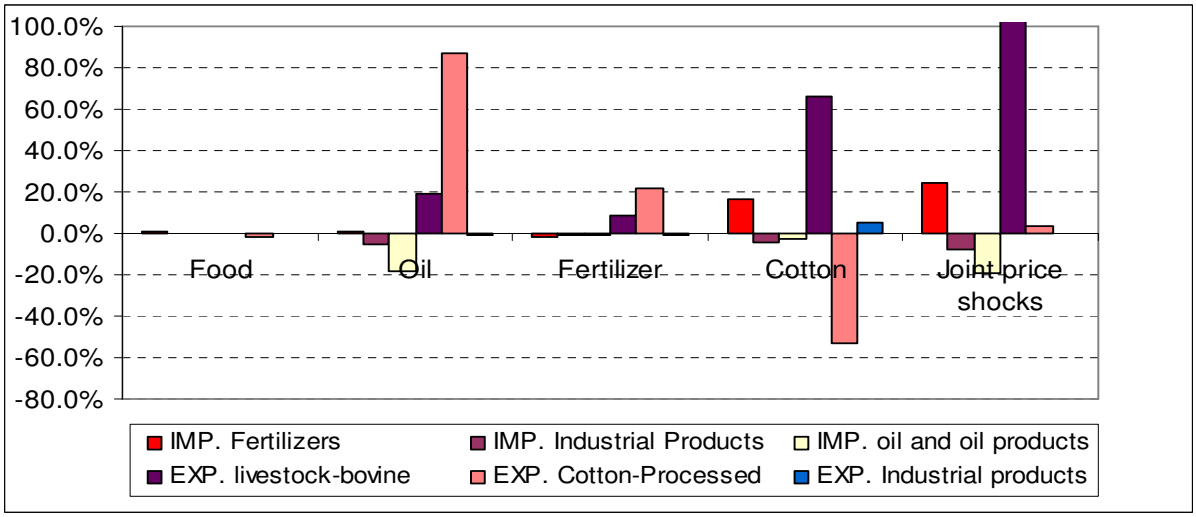
Under the flexible lower-bounded wage regime, the differences with the fixed wage regime are slightly less pronounced than in absence of the lower bound.

Figure 8.2a Variation of main import and export commodities. Simulations with fixed, flexible and lower-bounded family-labour wage.

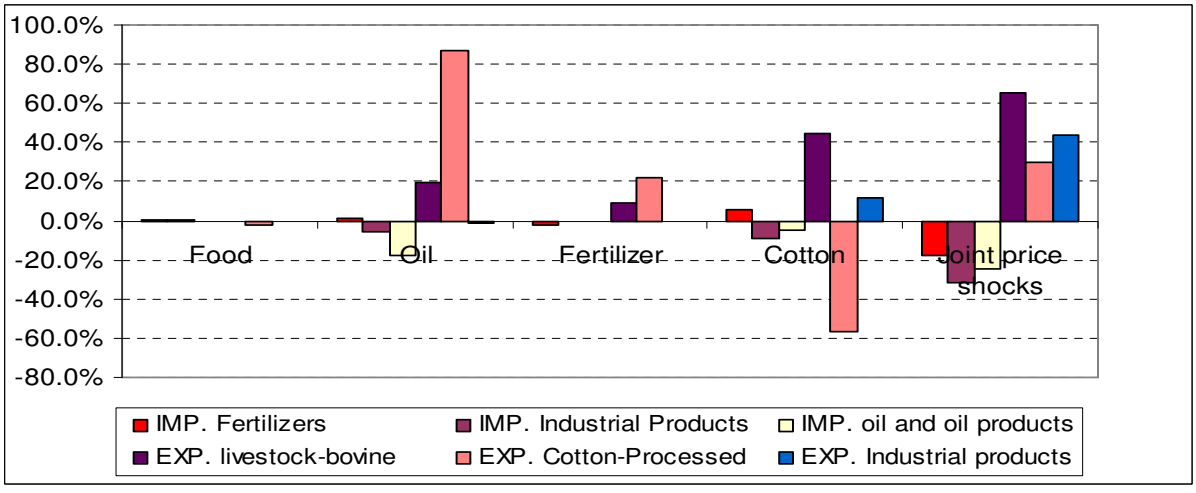
A. Fixed family-labour wage



B. Flexible family-labour wage



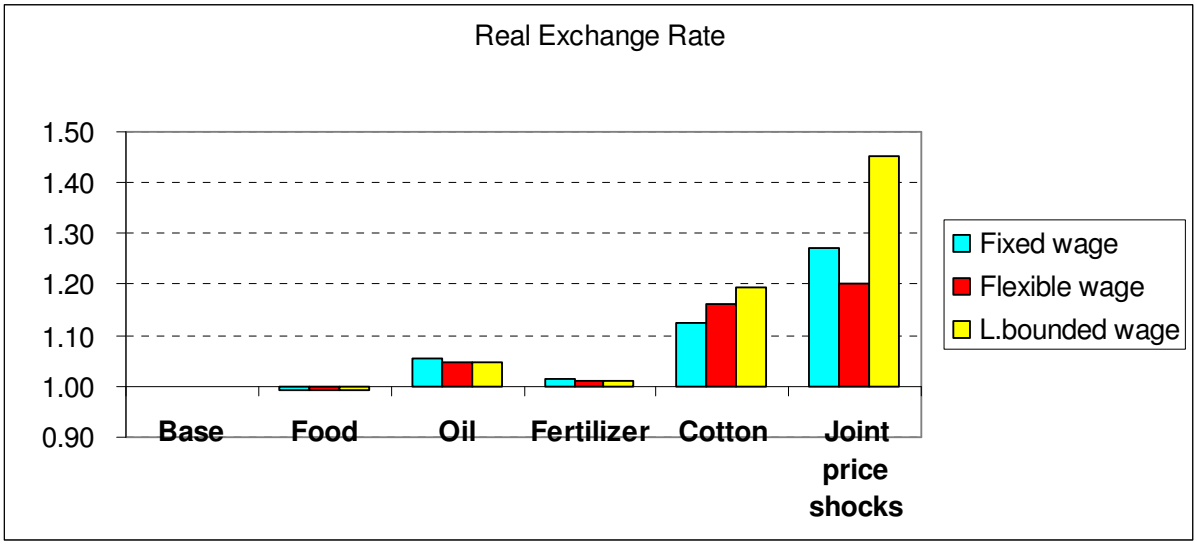
C. Lower bounded family-labour wage



The "Joint price shocks" simulation shows different pictures depending on the different wage regimes. With fixed wage, all the main import items (oil, fertilizers and industrial products) shrink (between -20% and -25%), cotton exports significantly drop (-64%). On the other hand, the agents shift factors from the cotton to the livestock sector as this becomes relatively more competitive. In addition also the export of industrial products significantly increases (+17% and +45% respectively) (figure 8.2a panel A, "Joint price shocks").
With flexible labour wage, the economic system adjusts to shocks quite differently. Cotton exports in physical terms remain substantially unchanged, as labour wage reductions absorb the negative impacts of the international price downturn. In addition, the increased absorption of labour at a reduced wage generates the drastic expansion of the livestock sector (+632%), which in turn pulls also the increase of imports of fertilizers and pesticides (+22%).
The lower-bounded wage regime generates a more "balanced" adjustment on the export side, as all the three main export commodities (cotton, livestock and industrial products) expand at rates between 30% and 66%, while all the main import products (oil, fertilizers and industrial products) reduce at rates between -17% and -32%.

All the price shocks under any wage regime, except the increase of food prices, imply a currency devaluation in real terms, as shown in figure 8.3. While at the base one unit of foreign currency costs one unit of the composite basket of consumer goods (the CPI index, which is the numeraire), under the different scenarios one unit of foreign currency costs more than one unit of the composite consumer good basket. On the one hand, through the devaluation of the domestic currency, which implies a reduction of the general level of domestic prices including the factor wages, with respect to foreign ones, the economic system restores its relative competitiveness towards the international markets, allowing the country to keep exporting. On the other hand, the reduced purchasing power allows for a reduction of imports, thus enabling the economic system to respect the constraint on the balance of trade. A comparison of the different wage regimes highlights that a larger devaluation occurs the cotton price simulation under the flexible wage regime (1.15) and an even larger when the lower bound applies (1.19). Under the flexible wage regime this is probably due to the higher pressure on imports coming from increased private consumption (+2%). Furthermore, when the lower bound applies, further devaluation allows on one side, restoring the competitiveness of the system no longer achievable through further reductions of wages and, on the other side, achieving a new balance of trade in foreign currency, no longer exogenously fixed.

Figure 8.3. Real exchange rate for fixed, flexible and lower bounded family labour wage



The quantities of exports required to obtain the foreign currency necessary to buy the imports that the system requires, are based on the price of exports in terms of imports, the so called "**terms of trade**", which tell how much the country can import per unit of export. Changes of international prices alter the terms of trade of the country, i.e., the quantity of import one unit of export can buy. Terms of trade indexes are calculated as the ratio between an index of international prices of exports and an index of international prices of imports. As imports and exports are bundles of goods, the change in price of each good alter the price of the bundle in relation to the magnitude of the change and the weight of the specific good in the bundle. Therefore simulated price shocks alter the terms of trade of the country, i.e. its "purchasing power" with respect to the rest of the world both through: 1) the exogenous changes in international prices; and 2) the endogenous changes in the composition of bundles of imported and exported goods.
If the price index of exports increase, other things equal, the terms of trade "improve", i.e. the country can import more with the same quantity of exports, vice-versa if the price index of exports decreases. The opposite occurs if the price index of imports increases other things equal (worsening of the terms of trade), and, vice-versa, if the price index of imports decreases (improving terms of trade).

Two sets of indexes of the terms of trade have been calculated (see figure 8.3a). The first set of terms of trade indexes is based on the Laspeyres price indexes of exports and imports. The Laspeyres-based terms of trade indexes change through to the various price shock simulations, but are not sensitive to the different wage regimes, because the price changes are the same for all the wage regimes considered and the quantities used to weight the prices are those of the baseline:

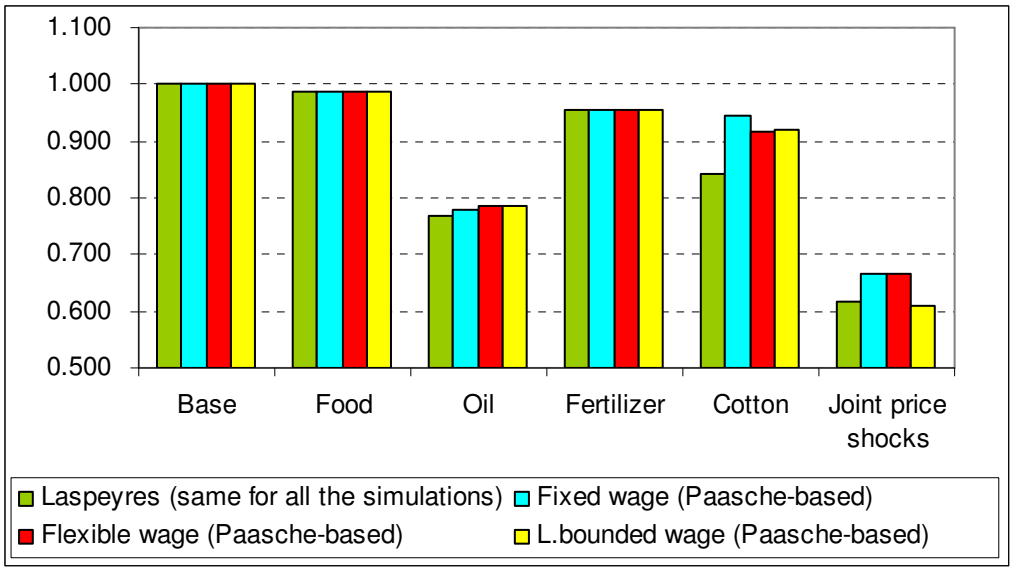
Laspeyres-based $TT_{SB(L)}$ and Paasche-based terms of trade indexes $TT_{SB(L)}$ are respectively:

$$TT_{SB(L)} = \frac{\sum_{i=1}^{e} PWE_{S_i} QE_{B_i}}{\sum_{i=1}^{e} PWE_{B_i} QE_{B_i}} \Big/ \frac{\sum_{j=1}^{m} PWM_{S_j} QM_{B_j}}{\sum_{j=1}^{m} PWM_{B_i} QM_{B_i}} \qquad TT_{SB(P)} = \frac{\sum_{i=1}^{e} PWE_{S_i} QE_{S_i}}{\sum_{i=1}^{e} PWE_{B_i} QE_{S_i}} \Big/ \frac{\sum_{j=1}^{m} PWM_{S_j} QM_{S_j}}{\sum_{j=1}^{m} PWM_{B_i} QM_{S_i}}$$

Where: PWE and PWM are the international prices of imports and exports respectively; QE and QM are the quantities of exports and imports respectively; i and j are indices for the exported and imported commodities respectively; and S and B are indices referring to a given simulation and to the baseline respectively. The Laspeyre-based Terms of Trade index $TT_{SB(L)}$ is the same for all the wage regimes as under all the regimes the exogenous simulated price changes are the same and the weighting quantities are those of the baseline, thus not related to the specific simulations, while the Paasche-based Terms of Trade index changes under the different wage regimes as the weighting quantities are simulation-specific.

When the terms of trade worsen, more exports have to be devoted to import the same quantity of goods, reducing the quantities available for domestic absorption, other things equal. Therefore, an increase of GDP in real terms, associated to a degradation of the terms of trade, does not necessarily implies that the quantities of goods and services available to the country increase at the same rate.
The larger degradation of the terms of trade occurs for the Oil price shock and the Joint price shock simulations, under all the wage regimes (see figure 8.3a). That is why, for those simulations, there is a large divergence between the variations of the real GDP (moderately negative or slightly positive, depending on the different wage regimes) and the variation of the private consumption, strongly negative for both simulations under any wage regime (compare rows g and by in the panels A, B and C of table 12.

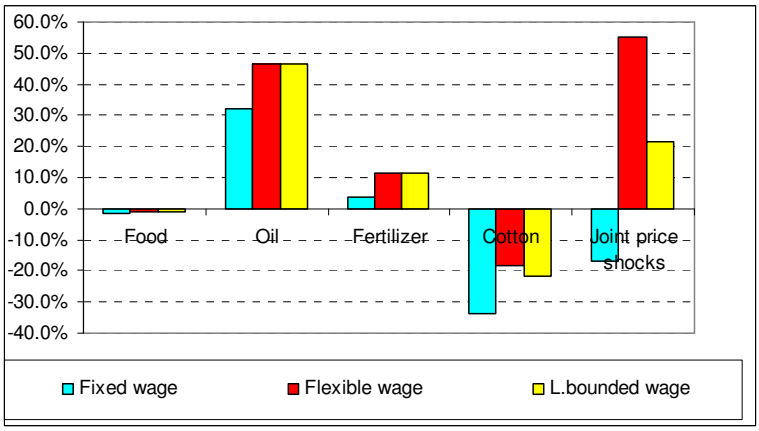
Figure 8.3a Terms of trade for fixed, flexible and lower bounded family labour wage



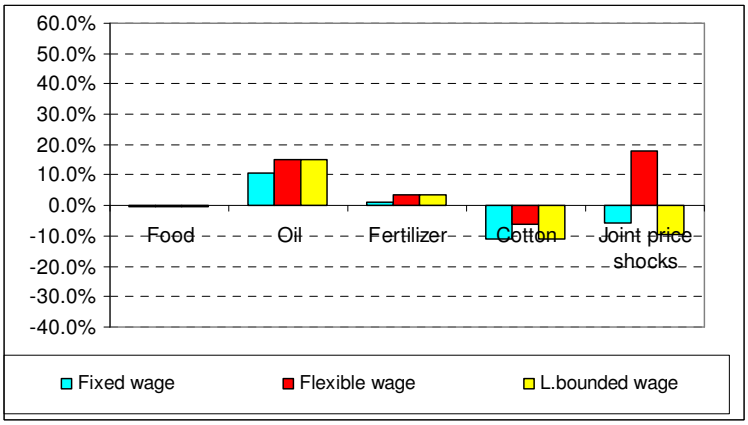
The variations of quantities of exports and imports affect the export income and the import bill in foreign currency. Upward shocks on import prices of oil and fertilizers raise the import bill under all the wage regimes (see figure 8.3 part B).

Figure 8.3b. Balance of trade: Export income, import bill and balance of trade in foreign currency.

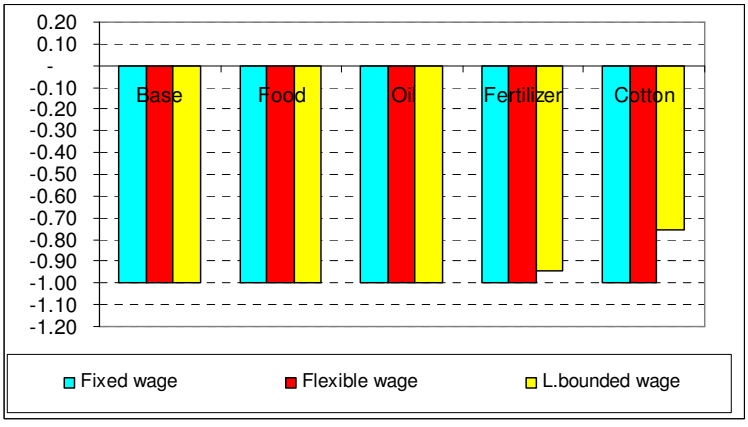
A. Export income in foreign currency (% variation with respect to the base)



B. Import bill in foreign currency (% variation with respect to the base)



C. Balance of trade in foreign currency (index: absolute value at base =1)

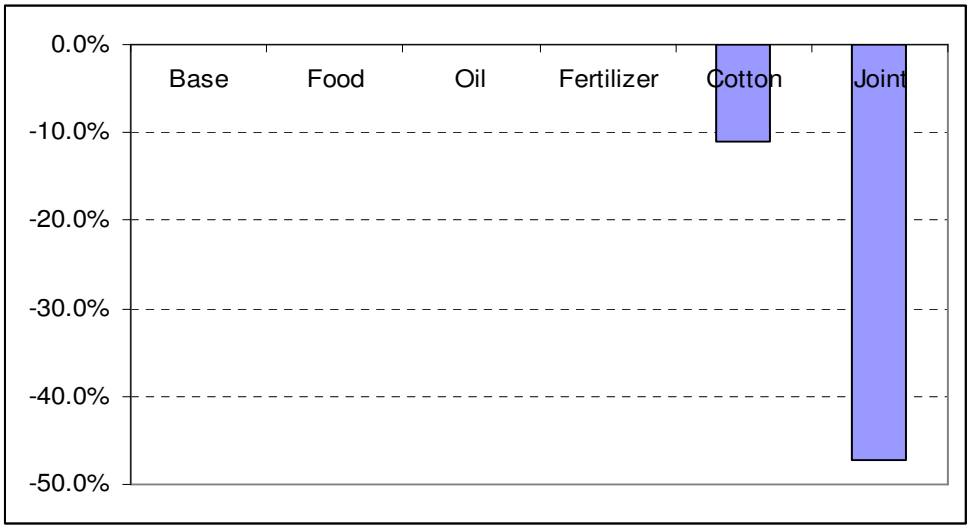


By way of consequence, due to the fact that the balance of trade in foreign currency is fixed (see figure 3, part C), also exports increase. Variations are stronger with flexible wages due to an overall expansion of the economic system under this wage regime.

Conversely, the shock of cotton price reduces both exports and imports. Reductions however are more contained under the flexible wage regime as the increased availability of labour and its reduced cost allows better reacting to the price shock. The lower bound on wages partially reduces this capacity of reaction. The Joint price shock has different impacts on imports and exports according to the wage regime. While with fixed wages imports and exports shrink, with flexible wages they significantly expand. Again, this is due to the possibility of the system to activate the export some commodities, e.g. livestock products (see figure 8.2a, panel B) otherwise not competitive.

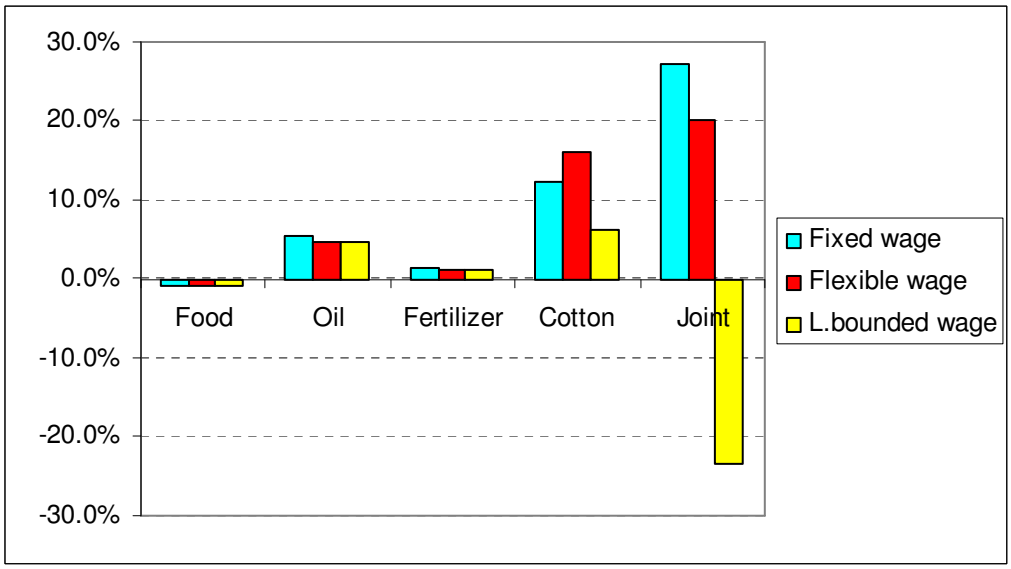
The issue of restoring the competitiveness of the economic system facing international price shocks can be better understood looking at the results of the simulations run under the lower bounded wage regime. Under this regime, not only the wages cannot fall below the 20% of their initial level, but the foreign transfers adapt to allow the system to respect this constraint. Therefore, to restore its competitiveness the system simultaneously adjusts the exchange rate and the required transfers form abroad to achieve the equilibrium of the current account. In addition, the exchange rate must be such that the net external trade be compatible with the level of output where the marginal value product of the family labour corresponds to the lower bound wage. When the lower bound applies, i.e. for the cotton and joint price simulations, the foreign transfers to the government budget have to reduce of more than 10% and almost 50% respectively in foreign currency (figure 8.3a). A reduced inflow of foreign currency leads to a stronger devaluation of the domestic currency than under both the fixed and flexible wage regimes (see figure 8.3). This devaluation allows the economic system to restore its competitiveness and even expand the traditional cotton export. Furthermore, it allows for the expansion of the exports of livestock and industrial products (see figure 8.2a, part C). Overall, the reduction of the foreign transfers to the government leads to an improvement of the balance of trade (say, a reduction of the trade deficit), particularly important for the joint price shock simulation (figure 8.3c, part C).

Figure 8.3c Transfers from ROW to the government budget in foreign currency: (% changes)



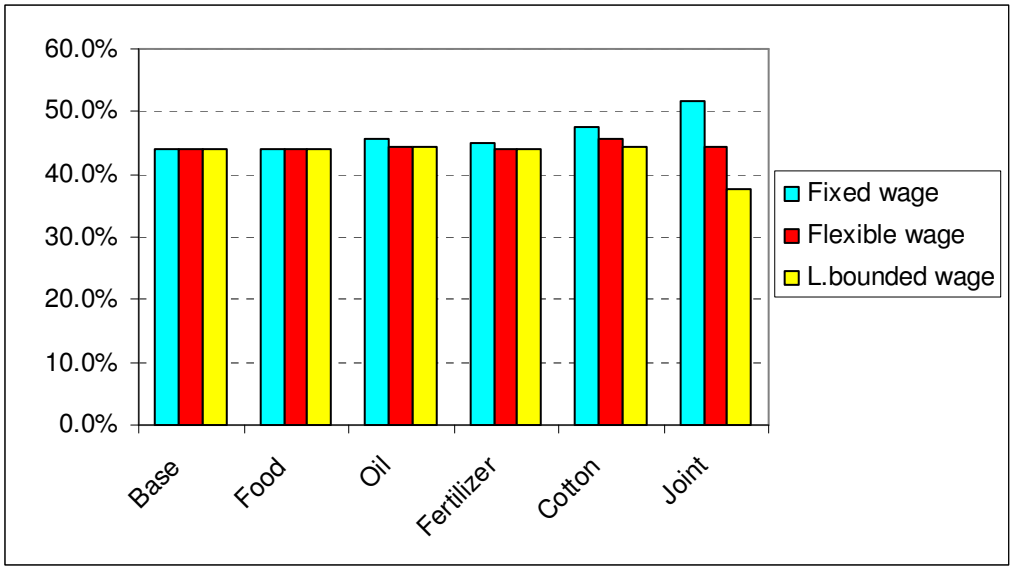
Foreign transfers in domestic currency (figure 8.3 d) for the cotton price simulation, increase in spite of their reduction in foreign currency, due to the increase of the exchange rate. However, for the Joint price simulation, the upward shift of the exchange rate is not large enough to countervail the sharp decrease of the foreign transfers, resulting in a drastic reduction of foreign transfers in domestic currency (-23%).

Figure 8.3d Transfers from ROW to the government budget (domestic currency)



Downward shifts of foreign transfers in domestic currency modify the "dependency ratio" i.e. the share of the budget income funded by foreign agencies (figure 8.3e). This particularly applies to the Joint price simulation, for which, the dependency ratio reduces from 43% at the baseline to 38%.

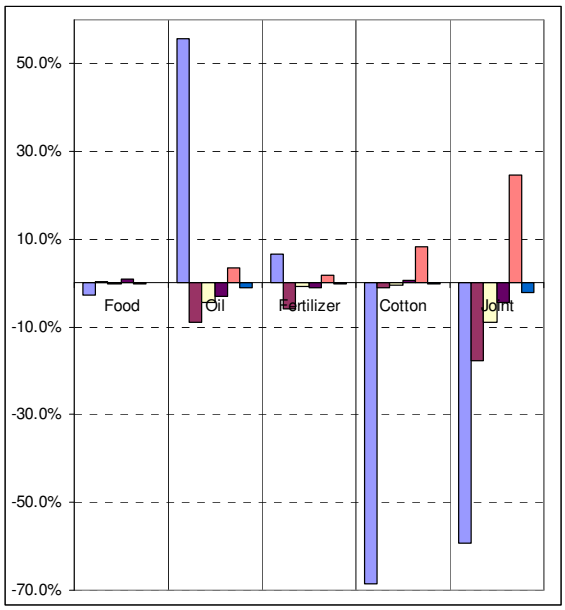
Figure 8.3e Transfers from ROW to the government budget as % of budget income



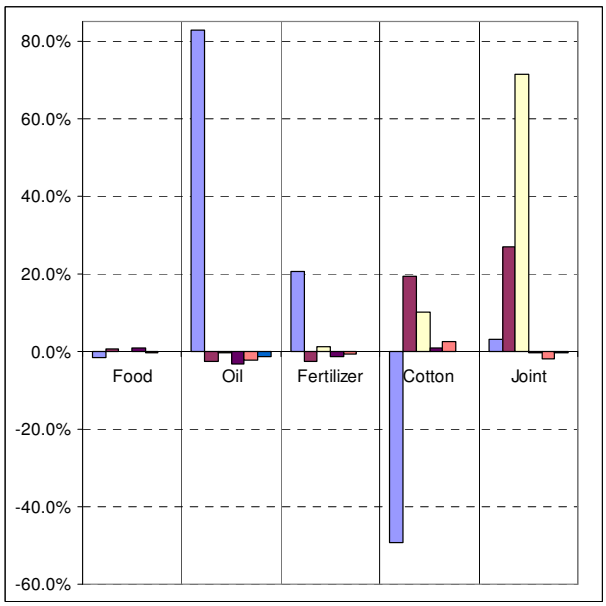
The impacts of shifts of international prices on activity levels reflect to a good extent the changes in import and export commodities described above. Under all the wage regimes, the activity level of cotton (grain production and ginning) increases for the upward Oil and Fertilizers price simulations and decreases for the downward cotton price simulation (figure 8.3f). However, the wage regime strongly affects the activity level of cotton for the Joint price shock simulation. With fixed wages, the cotton activity shows a -60% reduction. With flexible and lower bounded wages it increases of 3% and 28% respectively. The significant growth of the cotton activity under the lower bounded wage is due to the fact that the system restores his competitiveness in the main export commodity, not necessarily through the lowering of wages only, but through a reduced inflow of foreign currency.

Figure 8.3f. Activity levels: % changes with different family-labour wage regimes

Fixed wage

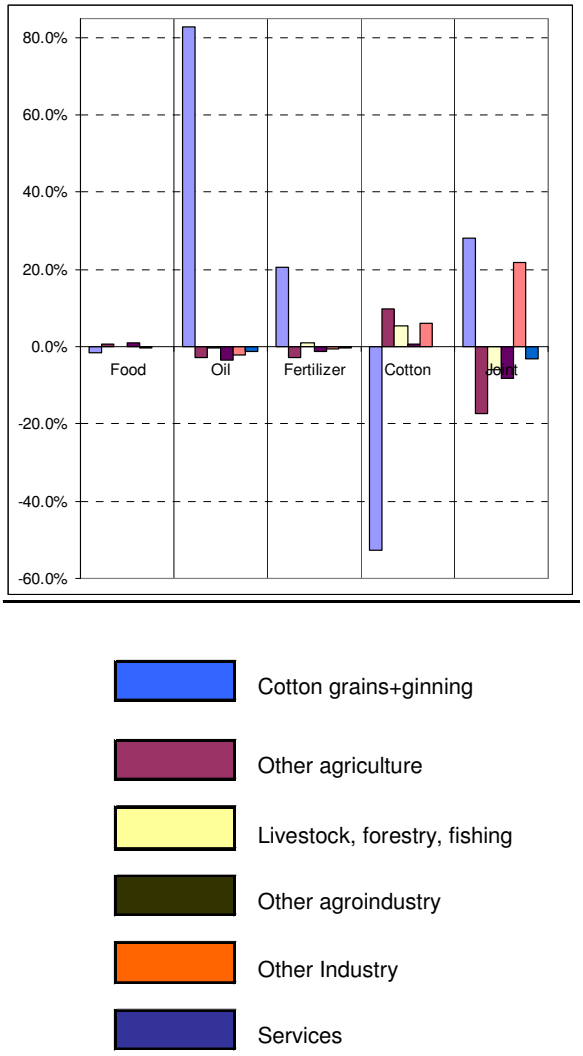


Flexible wage



Lower-bounded wage

Legend



Source: General equilibrium model results

Reduced foreign transfers to the government allows for a devaluation of the domestic currency in real terms, i.e. a general reduction of the level of domestic prices (including the remuneration of all the factors) with respect to the international prices. The significant inflow of foreign currency due to foreign transfers appears in this context as a deterrent to the development of the external competitiveness of the production sectors of the country. It appears here that foreign transfers generate a sort of "Dutch-Disease"[209] effect, sustaining an exchange rate which does not allow export sectors to afford reduced export prices.

The sign and magnitude of foreign transfers (aid) to the export potential of a less industrialized country is a debated issue. For example, Sundberg and Lofgren (2005), on the basis of a model for Ethiopia find a strong relationship between the increase of aid and the fall of exports. However IMF (2007) reports that, specifically for Burkina

[209] The Economist (1977). "The Dutch Disease", November 26, 1977. pp. 82-83.

Faso, the "Dutch Disease" related to aid absorption is not an issue[210]. Barder (2006), after reviewing some literature on this issue, argues that foreign transfers (aid), and even aid increases may not be detrimental to the welfare of a country in the long run provided that; 1) it is channelled towards increasing productivity; 2) its impact on exports is marginal; and 3) finance public or private consumption[211]. By reversing these considerations, it can be inferred that aid reductions may be detrimental in the following cases: 1) they reduce the potential of the country to increase its productivity; 2) don't have a beneficial effect on exports; and 3) reduce the potential for private consumption.

The cases above however don't apply to the specific situation under investigation. The significant reduction of foreign transfers resulting from the adjustment of the system to joint price shocks under the lower bounded wage regime is not expected to have negative impacts on the productivity of the country as both investment and government consumption are fixed in real terms. In addition, the reduction of transfers has a positive impact on net exports, as the balance of trade improves. The only drawback of the reduction of foreign transfers is the larger reduction on the private consumption (-24%), compared with the one under the other tow wage regimes (compare row b of panel C in table 12, with row b in panel A or B). Despite the fact that it does not look reasonable supporting the idea that medium long term aid is not detrimental only because it allows an economic system consuming more than it would be able to do without aid, a further investigation on private consumption, income expenditure and welfare is required to highlight the welfare impacts of the various price shocks under different wage regimes.

The aggregate changes of private consumption reflect diversified changes in welfare levels enjoyed by the different groups of households. The equivalent variation, i.e. the amount of money that households would be willing to give up to avoid the price shocks measured as percentage of the consumption expenditure at the benchmark, highlights that, overall, under the flexible wage regime, the negative impacts of shocks are more limited than under the fixed wage and the lower bounded regimes (Figure 8.4 panel B, compared with panel A and C). The Equivalent Variation is the result of a joint variation of price changes and nominal expenditure. Figure 8.4a reports the Laspeyres consumer price index and the nominal expenditure percentage changes by wage regimes. A detailed interpretation of the EV under the different wage regimes is provided here below.

---

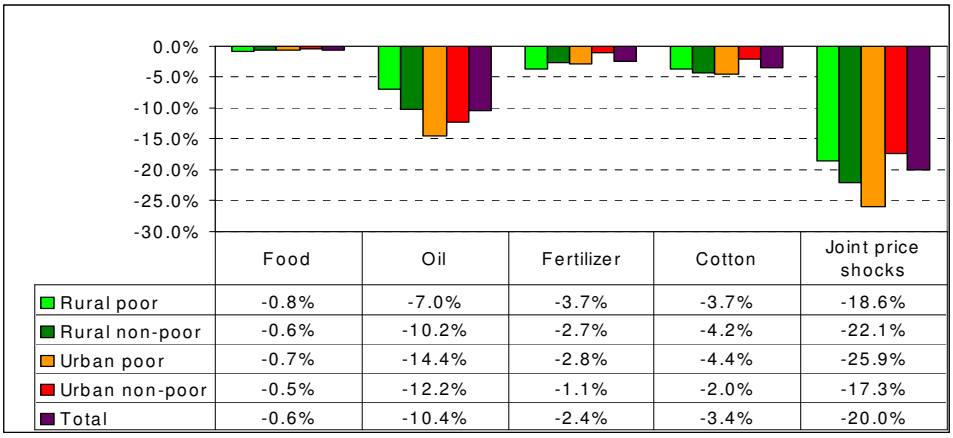
[210] IMF (2007).The IMF and Aid to Sub‐Saharan Africa. Evaluation report, p.48. Independent Evaluation Office of the IMF. Whashington D.C. USA

[211] Sundberg, M, and Lofgren, H. (2005). Absorptive capacity and achieving the MDGs: The case of Ethiopia. In Peter Isard, Leslie Lipschitz, Alexandros Mourmouras, and Peter Heller (eds). *Macroeconomic Management of Foreign Aid: Opportunities and Pitfalls*. International Monetary Fund, Washington, DC.

Barder, O. (2006) A Policymakers' Guide to Dutch Disease. Working Paper Number 91 July 2006. Center for Global Development. London

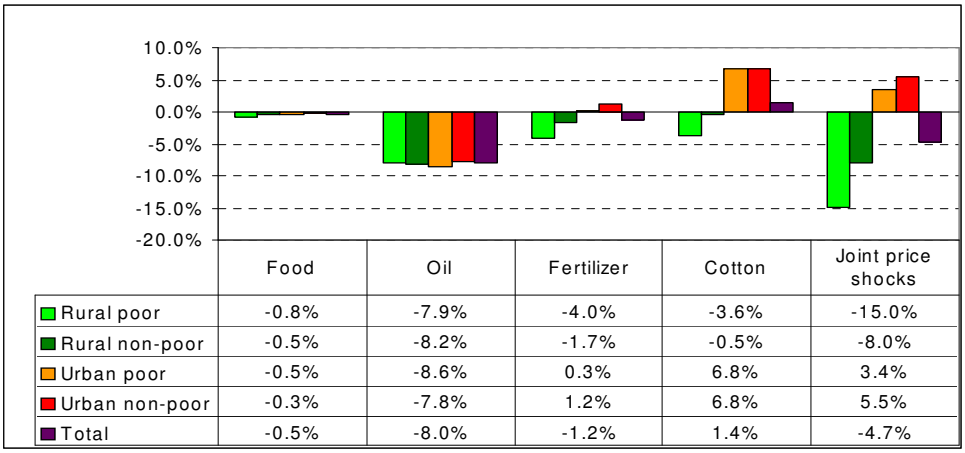
Figure 8.4 Equivalent Variation with fixed, flexible, lower-bounded family labour wage

Panel A: fixed family-labour wage



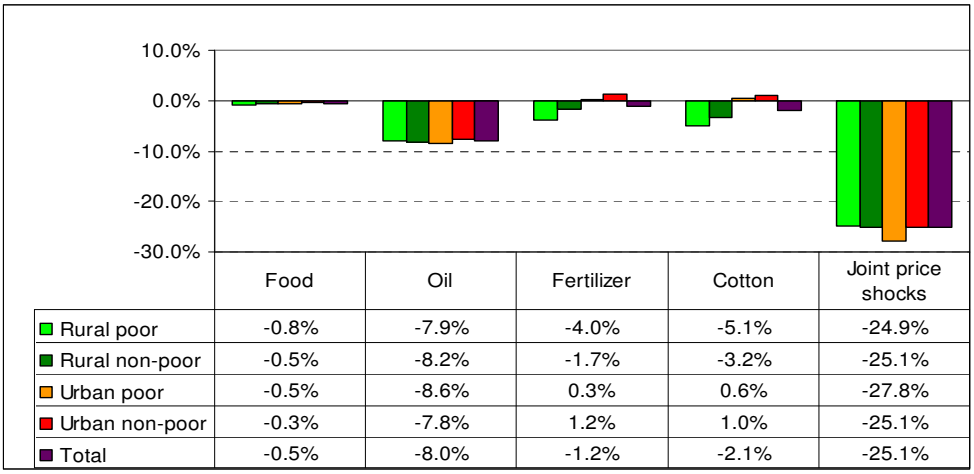
	Food	Oil	Fertilizer	Cotton	Joint price shocks
Rural poor	-0.8%	-7.0%	-3.7%	-3.7%	-18.6%
Rural non-poor	-0.6%	-10.2%	-2.7%	-4.2%	-22.1%
Urban poor	-0.7%	-14.4%	-2.8%	-4.4%	-25.9%
Urban non-poor	-0.5%	-12.2%	-1.1%	-2.0%	-17.3%
Total	-0.6%	-10.4%	-2.4%	-3.4%	-20.0%

Panel B: flexible family-labour wage



	Food	Oil	Fertilizer	Cotton	Joint price shocks
Rural poor	-0.8%	-7.9%	-4.0%	-3.6%	-15.0%
Rural non-poor	-0.5%	-8.2%	-1.7%	-0.5%	-8.0%
Urban poor	-0.5%	-8.6%	0.3%	6.8%	3.4%
Urban non-poor	-0.3%	-7.8%	1.2%	6.8%	5.5%
Total	-0.5%	-8.0%	-1.2%	1.4%	-4.7%

Panel C: Lower bounded family-labour wage



	Food	Oil	Fertilizer	Cotton	Joint price shocks
Rural poor	-0.8%	-7.9%	-4.0%	-5.1%	-24.9%
Rural non-poor	-0.5%	-8.2%	-1.7%	-3.2%	-25.1%
Urban poor	-0.5%	-8.6%	0.3%	0.6%	-27.8%
Urban non-poor	-0.3%	-7.8%	1.2%	1.0%	-25.1%
Total	-0.5%	-8.0%	-1.2%	-2.1%	-25.1%

Under the **fixed wage regime**, the negative impacts on household welfare of the oil price shocks are more pronounced for of urban groups, due to the fact that these groups spend a larger part of their income on this commodity (see table 4), so their price index increases while their expenditure sharply decreases. On the other hand, the

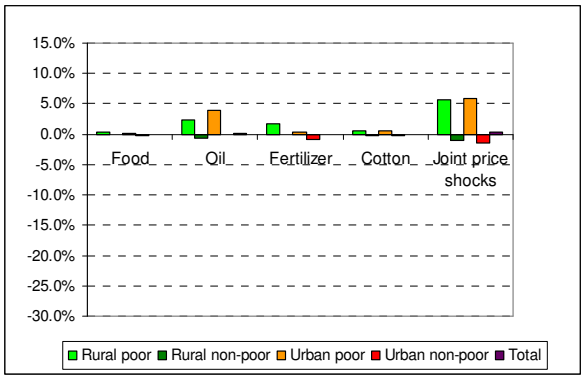
nominal expenditure of rural poor households only slightly reduces. This is due to the fact that the income from family-labour, which constitutes more than 50% of the income or rural poor, does not significantly change under this simulation (figure 8.5), thanks to the fixed wage (by hypothesis) and the limited reduction of the supply of family labour (figure 8.7). The welfare impacts of the cotton price shock is larger for rural non poor and urban poor groups due to the negative impacts on both primary production (cotton grains) and ginning, activities which involve both groups. The Joint prices shock under the fixed wage regime, affects more non poor and urban poor households, despite the fact that the income from family labour shows a 20% reduction, affecting the expenditure of rural poor households, which also face a 5% increase of their price index.

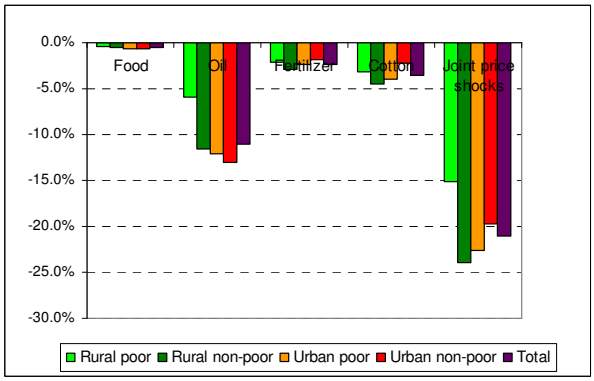
Under the **flexible wage regime** the *oil price shock* affects in a similar way the welfare of the different household groups (around -8%), despite the fact that the consumer price index of the urban groups increases more than the one of the rural ones. This is due to the fact that urban groups exhibit a more limited reduction of their nominal expenditure than the rural ones. The oil price shock affects the expenditure of rural poor through the reduction of the family labour income. The shock generates a 20% reduction in the family labour wage (figure 8.6), which, associated to a 10% increase in the labour supply (figure 8.7), leads to a -10% reduction of the family labour income (figure 8.5). The welfare impact of the *fertilizers' price shock* is essentially born by the rural households due to the reduction of the nominal expenditure, substantially due to a reduction of the family labour income. The *cotton price shock*, under this wage regime has quite important distributional impacts. While poor rural households are negatively hit (-3.6%), urban households (poor and non-poor) enjoy a welfare increase (almost + 7%). This is due to the fact that the decrease of the rural-poor consumer price index (-6%) is not enough to compensate the fall in the rural poor nominal expenditure (-10%), generated by a loss of the family wage income (-5%). The reduction in family wage income results from a -38% wage reduction, not offset by the increase of labour supply (+20%). In other words, the additional labour efforts provided are not enough to restore the level of expenditure achieved at the baseline, due to the sharp reduction of the family labour wage. The same considerations put forward for the cotton price shock apply to the *Joint price shock simulation*. The lower aggregate loss of welfare under the flexible wage regime (-4.7%) than under the fixed wage regime (-20%) is essentially due to the gains of the poor and non-poor urban household groups (+3.7% and 4.8% respectively) due to the additional labour efforts provided by rural households (+140%), which are left with less income from family labour (-50%) due to substantial reductions in family-labour wage (-80%), in spite of their increased supply of labour.
Overall, the flexible-wage regime is likely to reflect a situation where, on the one hand, poor rural households, which essentially supply the bulk of family labour, have to supply additional work at lower wages in order to keep enjoying analogous levels of welfare as in the case of fixed-wage regime. On the other hand, under the flexible-wage regime all the other household groups are less negatively affected or even positively affected by external shocks, provided that poor rural households bear the costs of the adjustment of the economic system to these shocks. However, the increase of family labour supply, and the decrease of the family labour wage under the cotton price shocks and joint price shocks simulations are extreme variations unlikely to occur in practice.

Figure 8.4a Laspeyres price index variations and nominal expenditure variations by type of household under different family labour wage regimes.

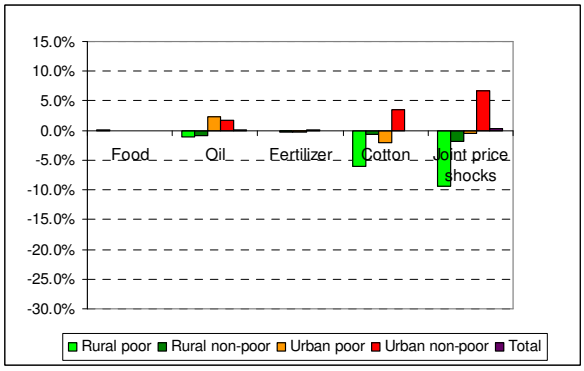
Laspeyres price index variations Nominal Expenditure Variations

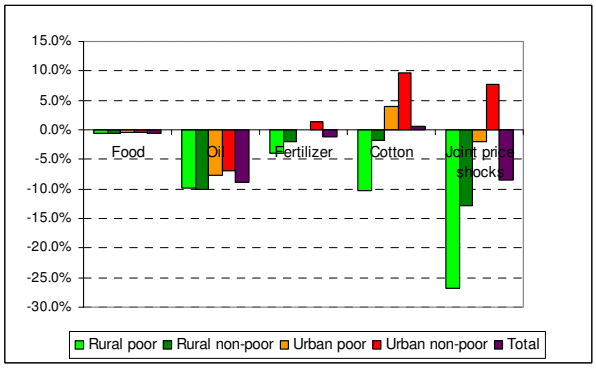
Panel A. Fixed family labour wage



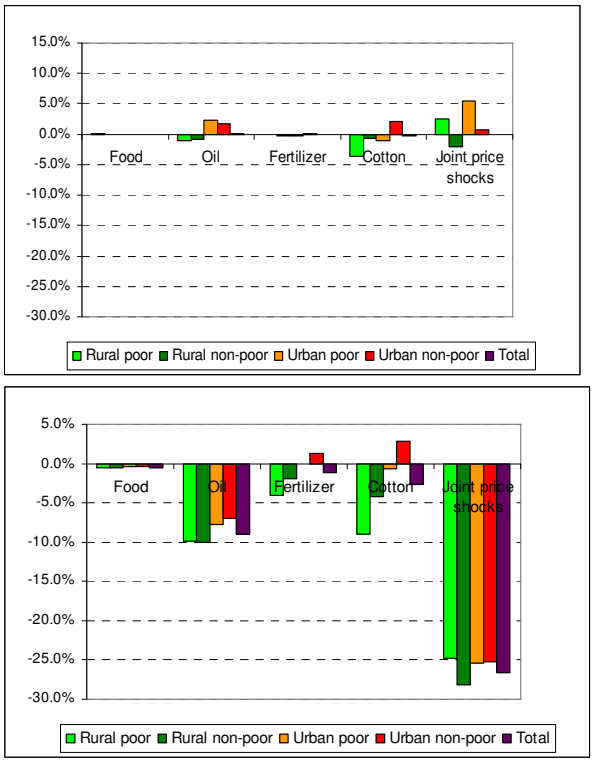


Panel B. Flexible family labour wage





Panel C. Lower bounded family labour wage



Under the **lower-bounded wage regime**, for the *cotton price shock* simulation, the aggregate loss of welfare (-2.1%) is smaller than under the fixed wage regime (-3.4%). However, the rural poor are more affected (-5.1%) than under the fixed wage regime (-3.7%). The reduction of welfare of rural poor is due to a reduction in their nominal expenditure not completely offset by the reduction in their consumer price index. The reduction of the nominal expenditure is mostly determined by the 25% reduction of the family-labour wage (which for this simulation reaches its lower-bound) not completely offset by the slight increase of the family labour supply. For the *Joint price shock*, the reduction of the aggregate private consumption highlighted in table 12, panel C, directly translates in a loss of welfare. The large devaluation led by the reduced inflow of foreign currency due to the reduction of transfers, favours exports, but, due to the degradation of terms of trade, it depresses imports, reducing the consumption possibilities of the country. However, the welfare loss hits almost equally all the household groups (-25%). A comparison with the fixed wage scenario, where the distributional impacts are relatively adverse to rural people and urban poor, suggests that, restoring the competitiveness of the system, affected by multiple international price shocks, through a consistent wage reduction (-25%) associated to a strong devaluation in real terms (-45%) and a sharp reduction of foreign transfers, leads to a stronger but more equitable loss of welfare. It has to be noted however, that, rural poor significantly suffer from this type of adjustment, as their loss of welfare shifts from -19% to -25%. This loss is partially due to the further reduction of the family labour income (figure 8.5) generated by a reduction of the wage, which reaches its lower bound. However, the reduction of the family wage contributes to contain the loss of employment, shifting the variation of the supply of family labour from -22% in the case of fixed wages to -10%.

Figure 8.5 Family-labour income with flexible, fixed and lower bounded family labour wage.

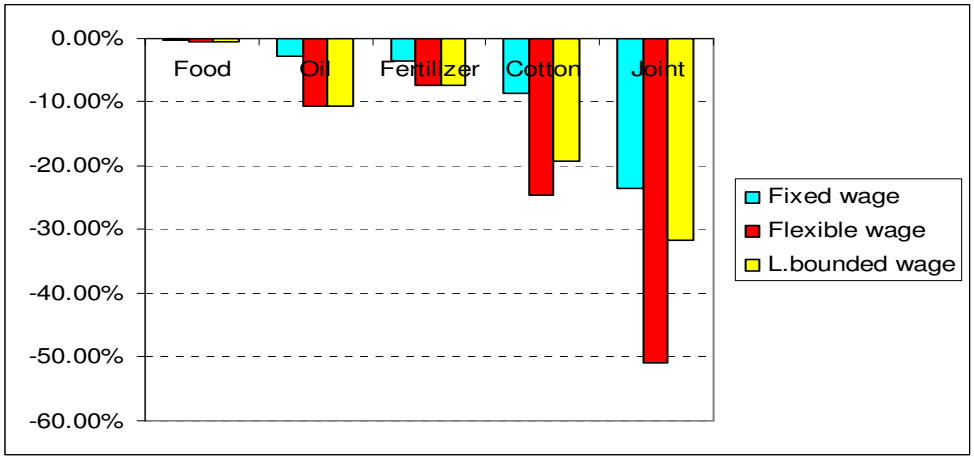
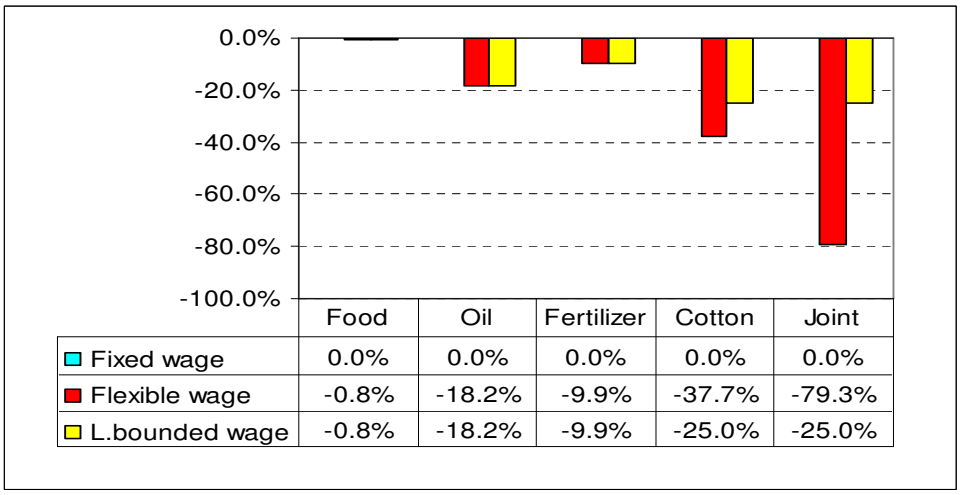
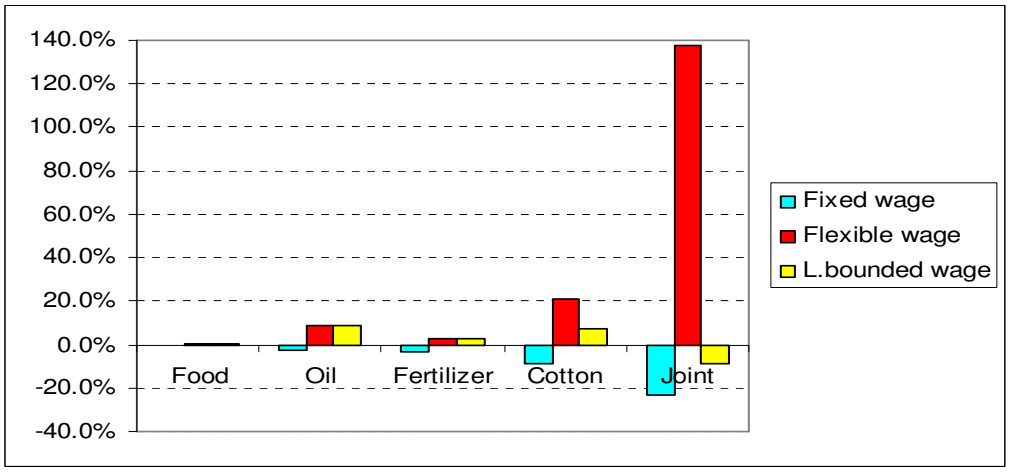


Figure 8.6 Family-labour wage under fixed, flexible and lower bounded wage scenarios



	Food	Oil	Fertilizer	Cotton	Joint
Fixed wage	0.0%	0.0%	0.0%	0.0%	0.0%
Flexible wage	-0.8%	-18.2%	-9.9%	-37.7%	-79.3%
L.bounded wage	-0.8%	-18.2%	-9.9%	-25.0%	-25.0%

Figure 8.7 Family-labour supply with flexible, fixed, lower-bounded family labour wage



6.6. Implications of alternative macro and factor market closures

From the comparisons carried out in the previous section, it is apparent that analytical results on impacts of international price shocks crucially depend on modeling choices. Indeed, alternative macro and factor closures radically change the results of models. As a natural consequence, policy advice based on such results can be biased if the analyst is not aware of the implications of changing one or more assumptions on which the analysis rests.

In the specific case analyzed above, the actual availability of additional domestic factors, specifically family labour and the flexibility of wages may contribute to countervail negative external shocks but may have strong adverse distributional impacts.

In addition, considering the extent to which under some simulation scenarios, notably the "cotton" and the "joint price shocks" ones, family wages shrink if left free to vary, we should wonder whether these scenarios can be considered realistic in the light of the current level of actual agricultural wages and wages enjoyed by family labour, which are almost close to the subsistence level. Analogous considerations apply to the supply of family labour, which under the flexible-wage regime, for the "joint-price shock" scenario more than doubles. In these cases, imposing lower bound to wages (as considered in figure 8.1 panel B) better reflect the likelihood of possible adjustments of the economic system. Imposing realistic lower bounds to wages allow using the analytical findings obtained assuming a flexible-wage regime for actual policy advice.

Under the lower bound regime, it results that, in presence of adverse simultaneous international price shocks on exports and inputs, the current level of foreign transfers lowers the flexibility of the system for adjustments to international price shocks. Restoring the competitiveness of the system through a moderate wage reduction associated to a consistent devaluation in real terms and a cut of the foreign transfers, leads to improving selected macro-economic indicators such as the balance of trade

and the dependency ratio, crucial for economic systems whose attained level of welfare is to a large extent supported by foreign aid and foreign loans. In addition, all this leads to a stronger but more equitable loss of welfare. However, this type of adjustment requires additional policy measures to improve the productivity of factors and income distribution because the losses of welfare associated to the restoration of the competitiveness, affected by international price shocks, may not to be affordable by the weaker layers of the society.

7. Technological Changes under "Good Agricultural Practices"

Among the possible policies to contrast international price shocks, policy measures aimed at increasing the productivity of factors and restoring occupational levels play an important role. Since 2005, the Food and Agriculture Organization of the United Nations (FAO UN), in collaboration with the "Institut de l'Environnement et de Recherches Agricoles (INERA)" (Institute for the Environment and the Agricultural Research) and the Ministry of Agriculture and Water Resources; support the "Union Nationale des Producteurs de Coton du Burkina Faso (UNPC-B)" (National Union of Cotton producers of Burkina Faso) in the promotion of the so-called "Good Agricultural Practices" (GAP) for the integrated Cotton-Cereals-Livestock production systems. This support comprises the identification and extension of appropriate production techniques, also by means of field experiments involving local farmers. In general terms, GAP aim at increasing yields by means of increased organic fertilisation, reduced use of chemicals (reduction of chemical fertilisers and elimination of pesticides) and increased use of agricultural labour[212]. Figure 11 reports average yields per hectare for maize and cotton induced by GAP technologies with respect to "ordinary" agricultural practices, calculated on the basis of the experimental data reported in FAO (2008)[213]. Figure 12 reports the different cost and value-added structure for maize and cotton under the two different agricultural practices as percent of the value of output.

It is apparent that, on the basis of the experimental results, GAPs lead to: a) a less input-intensive agriculture, making reduced use, in particular, of imported inputs; b) greater demand of factors per unit of output; and c) reduced land use, other things being equal, thanks to increased yields per hectare[214].

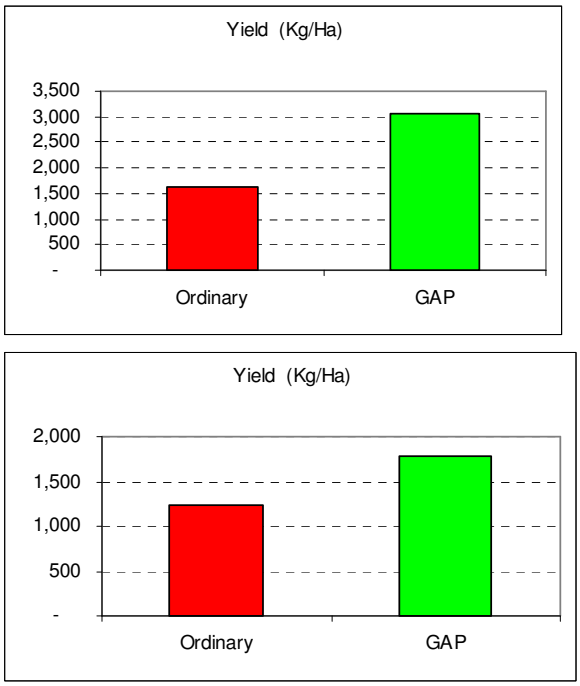
[212] For more details on conservation agriculture see e.g. Garcia-Torres, L., Benites, J., Martinez-Vilela, A. and Holgado-Cabrera, A.,(2003). (Eds.) Conservation Agriculture: Environment, Farmers Experiences, Innovations, Socio-Economy, Policy. Kluwer Academic Publishers, The Netherlands. For a review of the experiences and the potential of organic agriculture for poverty reduction see: Setboonsarng S. 2006 Organic Agriculture, Poverty Reduction, and the Millennium Development Goals August 2006 Asian Development Bank Institute (ADBI).

[213] FAO UN (2008): Formation participative sur les bonnes pratiques agricoles dans les systèmes de production coton-céréales-élevage. Rapport final de la campagne 2007-2008 FAO-AGPP, Rome ; UNCPB –INERA, Burkina Faso; March 2008. Unpublished.

[214] Detailed data on GAP based on FAO UN (2008), are reported in appendix.

Figure 11. Yields for Maize and Cotton With "ordinary" and GAP technologies.

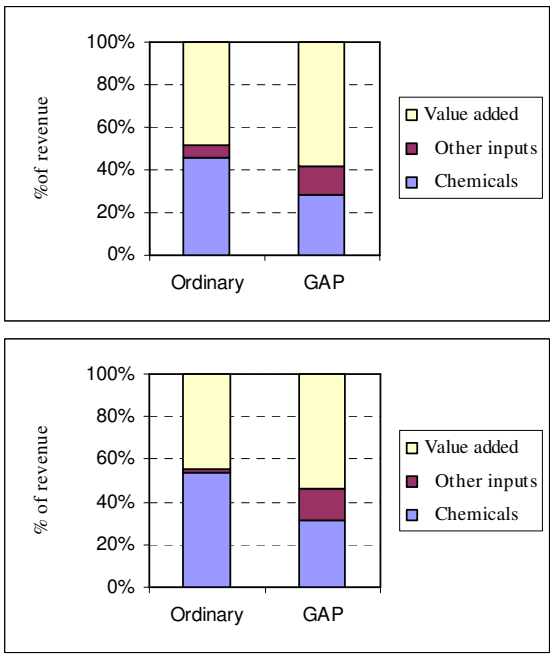
a) Maize b) Cotton



Source: Author's calculations on data reported in FAO UN (2008).

Figure 12. Input costs and value added for Maize and Cotton with "ordinary" and GAP technologies.

a) Maize b) Cotton



Source: Author's calculations on data reported in FAO UN (2008).

Given the importance of cotton as export commodity and fertilisers as imported inputs in Burkina Faso as discussed in section 5, it is interesting to see to what extent the

adoption of GAP technologies on a large scale could constitute a response to external shocks or, at least, could contribute to mitigate the negative impacts analysed in section 7.

The following simulations have been carried out using a CGE model in order to analyse the macro-economic and welfare impacts of a country-wide adoption of GAP practices for cotton, maize and other crops:

1. reduced use of chemicals (fertilisers and pesticides) (- 20% of chemicals per unit of aggregate intermediate input);
2. reduction (-20%) of the aggregate intermediate input per unit of output;
3. increased factor requirements (+20%) per unit of output;
4. joint effects of the three technological changes above; and
5. adoption of GAP practices in the context of international prices shifts.

Table 8 summarises the changes simulated with the CGE model, with respect to the base case assumed to reflect the "ordinary" technology[215].

Table 8: Simulations of technological changes for GAP

	Chemicals per unit of aggreg.input	Aggregated input per unit of output	Aggregated factor per unit of output
	(1)	(2)	(3)
Cotton	-20%	-18%	22%
Other crops	-24%	-19%	20%

As expected, reduced chemicals per unit of aggregated input and reduced aggregated input per unit of output (simulations 1 and 2) have positive impacts on GDP (see figure 13). On the other hand, increased factor use per unit of output imposes a burden on the socio-economic system (simulation 3). Overall, all GAP changes (simulation 4) have a slight positive impact on GDP (less than 1%), compared to the base case. GAP changes however become more relevant in the context of international price shocks, as they contribute to reduce the GDP losses from -7.8% (last shaded bar in picture 13) to -6.4%, (simulation 5). This is essentially due to the fact that GAPs reduce the demand of inputs affected by price shocks.

GAPs allow also reducing the domestic currency devaluation required to keep the external debt (in foreign currency) constant.[216]

[215] for cotton and other crop activities: simulation 1 reduces the technical coefficient of chemicals per unit of aggregate input (parameter "*ica"* in the model), simulation 2 reduces the technical coefficient of the aggregate input per unit of output (parameter "*inta*" in the model) and simulation 3 increases the value of the technical coefficient of the aggregate factor per unit of output (parameter "*iva*" in the model). If more detailed data on GAP technologies were available, it would be possible to simulate impacts of separate changes for energy consumption, agricultural labour and capital services.

[216] Recall that these results are obtained by keeping the external debt constant in foreign currency, allowing the real exchange rate to float to reach the equilibrium of the balance of payments. This implies that also the trade balance is kept constant in foreign currency.

Figure 13. GDP at market prices (at constant prices, % changes)

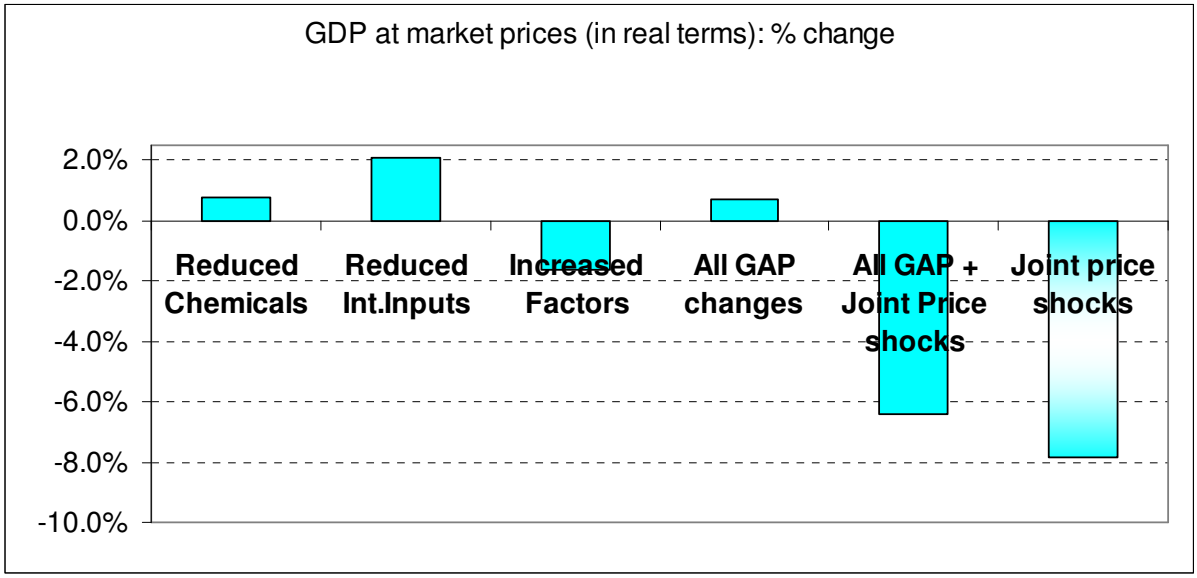


Table 9. Macro-economic impacts of Good Agricultural Practices

		Base	Reduced Chemicals	Reduced Int.Inputs	Increased Factors	All GAP changes	Price shocks + GAP	Price shocks
		Million FCFA	*% variation w.r.t.the base*					
a=b+c+d	**Total Absorbption**	**2,119,964**	**0.6%**	**1.8%**	**-1.4%**	**0.6%**	**-11.4%**	**-12.9%**
b	Private consumption	1,441,816	0.9%	2.6%	-2.1%	0.9%	-16.7%	-19.0%
c	Investment	279,655	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
d	Government cons.	398,493	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
e	Exports	149,849	0.7%	7.6%	-14.3%	-8.0%	-15.8%	-11.4%
f	Imports	458,157	0.2%	2.5%	-4.7%	-2.6%	-32.5%	-32.7%
g=a+e-f	**GDP at market prices**	**1,811,656**	**0.7%**	**2.1%**	**-1.6%**	**0.7%**	**-6.4%**	**-7.8%**

Figure 14: Real exchange rate adjustments

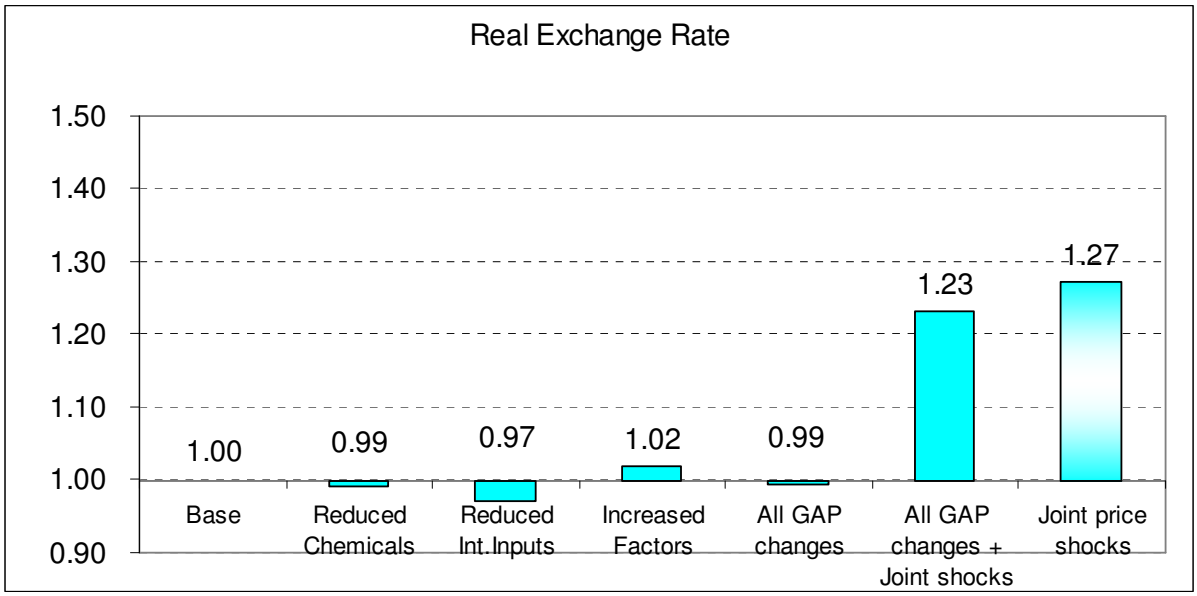
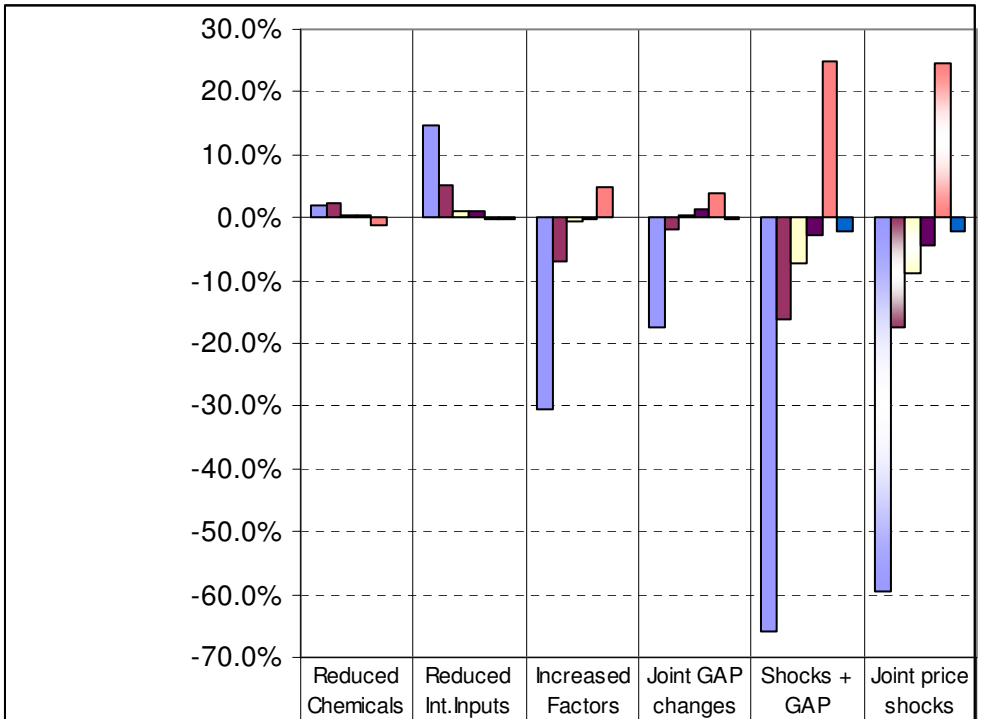


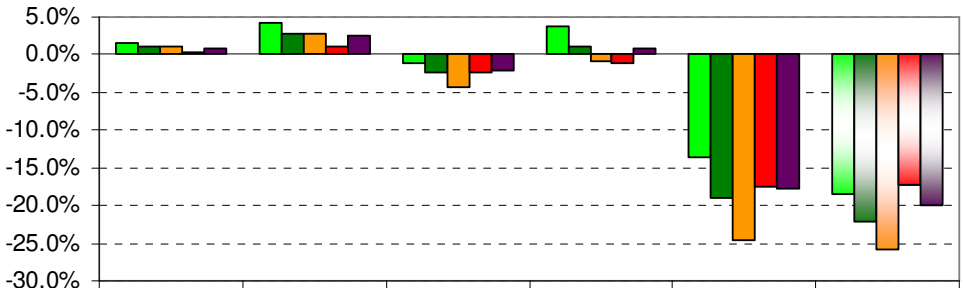
Figure 14a. Activity levels under Good Agricultural Practices and



	Reduced Chemicals	Reduced Int.Inputs	Increased Factors	Joint GAP changes	Shocks + GAP	Joint price shocks
Cotton grains+ginning	1.9%	14.7%	-30.4%	-17.4%	-65.8%	-59.4%
Other agriculture	2.3%	5.3%	-7.1%	-1.9%	-16.2%	-17.6%
Livestock, forestry, fishing	0.3%	0.9%	-0.6%	0.5%	-7.1%	-8.9%
Other agroindustry	0.3%	1.1%	-0.1%	1.3%	-2.7%	-4.5%
Other Industry	-1.2%	-0.2%	4.8%	3.9%	24.8%	24.6%
Services	0.0%	-0.3%	0.0%	-0.3%	-2.1%	-2.1%

The reduction of intermediate inputs per unit of outputs (specifically, imported chemicals) has obvious positive welfare impacts on households (figure 14, simulations 1 and 2). However, their reduction has to be read jointly with the required increase of factors per unit of output (simulation 3), as reported in simulation 4 (Joint GAP changes). The large scale adoption of GAP practices implies a slightly positive welfare impact on all the households (+0.5%). Furthermore, it shows important distributional impacts to the advantage of the rural poor (+3.2%) which more than compensate the slight losses of the urban segments of the population. Therefore, the adoption of GAP practices is likely to imply important positive improvements of poverty and food security.

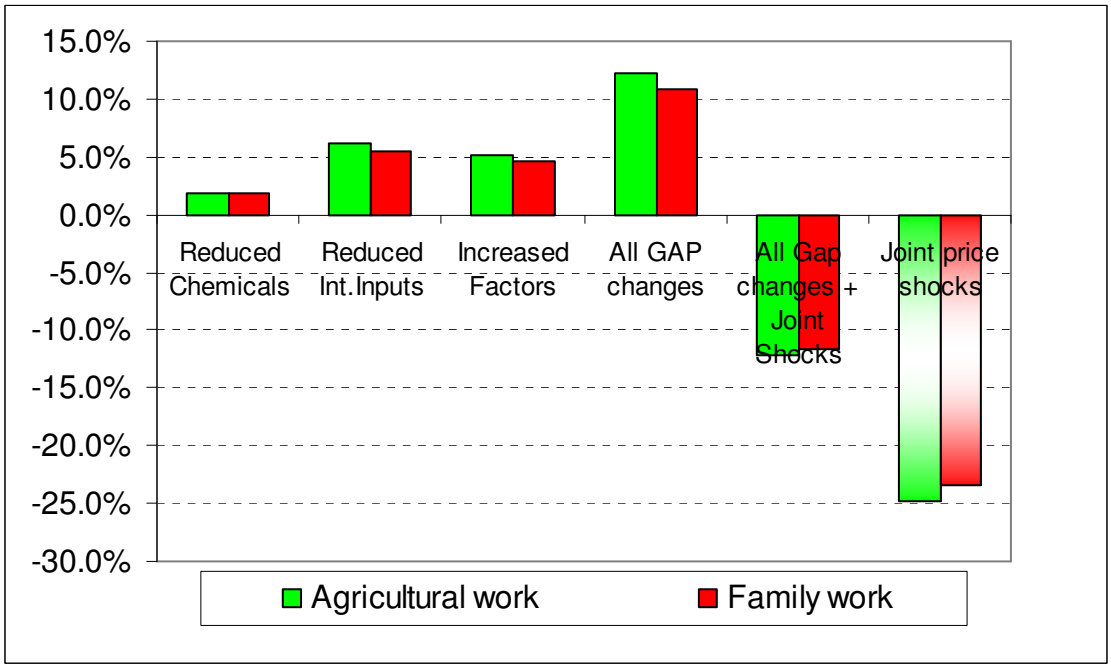
Figure 15. Burkina Faso. Households' welfare impacts (EV) of adoption of GAP practices and their mitigating impacts on price shocks. CGE simulations' results.



	Reduced Chemicals	Reduced Int.Inputs	Increased Factors	All GAP changes	All GAP changes+Joint shocks	Joint price shocks
Rural poor	1.5%	4.3%	-1.1%	3.7%	-13.5%	-18.6%
Rural non-poor	1.1%	2.9%	-2.3%	1.1%	-19.1%	-22.1%
Urban poor	1.1%	2.9%	-4.2%	-0.9%	-24.6%	-25.9%
Urban non-poor	0.4%	1.0%	-2.3%	-1.0%	-17.6%	-17.3%
Total	0.9%	2.6%	-2.1%	0.8%	-17.7%	-20.0%

Source: CGE model results

Figure 16. Factor use (% changes) under GAP and international price shocks scenarios



Source: CGE model results

The positive impacts of the adoption of GAP technologies are particularly important when looking at factor use. Figure 16 reports employment changes for agricultural wage work and family work. Note that under the full adoption of GAP (fourth scenario from the left), employment increases more than 10%.

This appears particularly important if considered in the context of international price shocks. Negative employment impacts of these shocks are definitely mitigated. The adoption of GAP shifts the job losses from almost -25% (figure 10, fifth scenario) to -13% (figure 14, fifth scenario).

8. Some policy implications

The analyses carried out above highlight that the country in general, and in particular the poorest layers of the population, are vulnerable to international price variations of selected commodities, both on the import and on the export side. This is essentially due to:

1. The dependency of the country on imports of energy products (oil in particular);
2. The need to rely on foreign markets for most of the industrial goods, including intermediate inputs, final consumption goods, investment goods and technology;
3. The dependency on the cotton sector as the main source of foreign currency;
4. The dependency of the country from foreign transfers to sustain the government budget.

It is important, in this context, to identify policies and strategies that while improving the overall macro-economic framework of the country, will also improve the welfare of the poorer layers of the population. Following Bhagwati (1988)[217], there are two alternative policy designs to achieve poverty reduction: a) the "indirect route", i.e. the use of resources to promote growth, relying on the "trickle-down" effects, and b) the direct route i.e. "*the public provision of "minimum-needs-oriented*" services relevant to achieve welfare improvements of selected layers. Bagwati however, suggests shaping the first route in such a way that it results in a "*pull-up*" strategy, i.e. a growth strategy biased towards generating income in the hands of the poor, in order to bring them out of poverty. This approach, which paved the way to what nowadays is named "pro-poor" growth, is probably what is needed in Burkina Faso.

Both routes however require resources for funding investment and/or providing services. The way chosen to procure these resources however is not neutral, particularly in presence of shocks affecting both import and export prices. In this situation the country needs to restore its competitiveness through a mix of policies affecting the productivity and related remuneration of factors, as well as through a real devaluation, implying a general re-alignment of the domestic prices with respect to the international ones. Breaking the dependency of the country from foreign transfers through a significant cut of foreign aid may have beneficial macro-economic impacts, such as an improvement of the balance of trade and a reduction of the budget dependency ratio. In addition, the burden of the international price shocks would probably be better distributed on all the layers of the society than in the case of reductions in the remuneration of factors supplied by the weaker segments of the society. However, the cut of foreign aid is most likely negatively affecting the consumption possibilities of the country. While this may not be a severe issue for non-poor households, it certainly constitutes a problem for the poor ones. Redistribution policies, including general fiscal schemes, need to be carefully designed to further improve the income distribution and shift the burden of adjustments from poorer to non poor social groups.

In any case, to achieve an endogenously sustained development path it is of crucial importance breaking the energy dependency, re-designing technologies, adapting consumption towards less import-intensive patterns and diversifying export sources are challenges that the country needs to address, in order to embrace more self-sustaining development strategies which would also be "pro-poor".

In order to address the energy issue, the exploration of alternative energy sources is a possible way forward. This implies carrying out a thorough analysis of the various options available, considering their technical feasibility, economic viability, environmental sustainability and their geo-political strategic implications.

Among the options that may have direct and significant impacts on rural areas and/or agricultural activities, bio-energy technologies look particularly interesting for exploration. While some of them may conflict with food production, as for example those requiring high quality-irrigated land (e.g. sugarcane-based ethanol or cassava-based diesel) others, such as Jatorpha-based diesel, if properly managed, might not conflict with other crops.

[217] Baghwati, J.N. (1988) Poverty and Public Policy. World Development. Vol 16, n. 5 pp. 539-555.

In addition, decentralised solar energy production might be particularly important for the development of specific off-farm activities in rural areas. While probably requiring comparatively larger investment, this technology could be also important for direct income generation if it is associated with the extension of the electricity network, which is planned in the 2010-2015 Strategic Development Framework of the country[218]. Once interconnected with the national electricity network, rural areas could also potentially become net sellers of energy.

The energy issue, but more generally, the import dependency, cannot be decoupled from technological research and technological choices, particularly relevant for predominant sectors such as agriculture. As shown above, the possibility to adopt on a large scale less import-intensive technologies, such as the "Good Agricultural Practices" (GAP) may lead to some improvement in the welfare of the poorest layers of the population. This implies developing and disseminating local knowledge on most adapted production and processing techniques and favoring their adoption by economic agents. Public policies aimed at supporting appropriate technological changes, while contributing to reduce pressure on the trade balance, may also be beneficial for employment generation and diversification of income sources. This may apply in particular to the adoption of carbon-fixing technologies, such as the technologies which increase the organic content of soil. These could receive adequate remuneration within the framework of current or future carbon-fixing international schemes.

As both the diversification of energy sources and the adoption of more appropriate technologies could contribute to reduce pressure on the balance of trade, appropriate policies to promote them could also lead to a reduction of pressure on export sectors, such as cotton and allowing for free resources, such as land and water, for other sectors.

9. Conclusions

This paper analysed the socio-economic impacts of selected international price shocks faced by Burkina Faso in recent years. It highlighted in particular that household welfare is significantly affected by oil and fertiliser price increases, as well as from the decline of cotton price. Among the possible ways to mitigate or countervail negative welfare impacts of international price shocks, the adoption of less-energy/import intensive technologies could play an important role.

Possible improvements of the analytical framework, in the context of enhanced, more detailed and updated information comprises, among other things: a more precise estimation of selected parameters such as the elasticities of transformation or substitution between exports and domestic products or the Armington elasticities. Also, an enhanced modelling of selected technological relationships, including the

[218] (2009) Strategie de développement 2010-2015. Ministère de l'Economie et des Finances (Draft, unpublished)

substitutability between capital and labour, as well as a closer investigation of factor uses and factor constraints.

However, in spite of some analytical limitations, essentially due to the weak information base, the findings of this work are quite interesting for their policy implications. It emerges in particular that the issue of energy is crucial if the country wants to achieve a sustainable reduction of poverty and food insecurity. In addition, reducing the energy dependency would also allow a reduction of the country's dependency on cotton, the main export crop, and from its international price variations.

This finding may also apply to other less industrialised net energy importing countries, with a similar socio-economic structure. A further general remark is that, to achieve sustained poverty reduction and food security in a given socio-economic system, it is of crucial importance to identify and fix the "bugs" that generate systematic and sustained drain of domestic resources, pretty much as in the energy sector in Burkina Faso, hampering local surplus accumulation and related endogenous growth potential.

10. References

Agrialerte, (2008) Alerte sur la situation de la campagne agricole des régions - Burkina Faso N°023-22/07/2008 Direction Générale des Prévisions et des Statistiques Agricoles (DGPSA), Direction du Système l'Alerte Précoce (DSAP) Ouagadougou. Information System on Food Security (SISA) www.sisa.bf

Anriquez et al (2003): Anriquez G, Foster, W, Valdéz A (2003): Agricultural Growth linkages and the Sector's Role as Buffer. Roles of Agriculture Project. FAO. Rome

Arrow, K.J. Chenery, H.B. Minhas B.S. and Solow R.M. (1961): Capital-Labour Substitution and Economic Efficiency, Review of Economics and Statistics, August 1961 pp 225-50.

Baghwati, J.N. (1988) Poverty and Public Policy. World Development. Vol 16, n. 5 pp. 539-555.

Barder, O. (2006) A Policymakers' Guide to Dutch Disease. Working Paper Number 91 July 2006. Center for Global Development. London

Bellù L.G. (2007). Windfall Oil Profits and Soaring Oil Bills: Some policy implications for Sustainable Development. EASYPol series. FAO UN. Rome

Blonigen, Bruce A., Joseph E. Flynn, and Kenneth A. Reinert (1997): Sector-Focused General Equilibrium Modelling, pp. 189-230 in eds. Joseph F. Francois and Kenneth A. Reinert, Applied Methods for Trade Policy Analysis. Cambridge, MA: Cambridge University Press.

Dervis, K., De Melo, J. and Robinson S. (1982): General Equilibrium models for development policy. World Bank Research Publication. Cambridge University Press.

Dixit, A., (1970) 'Growth patterns in a dual economy ', *Oxford Economic Papers,* 22 (2) July 1970, pp. 229-33.

FAO (2003): Anti-Hunger Programme: A twin-track approach to hunger reduction: priorities for national and international action Food and Agriculture Organization of the United Nations. Rome.

FAO (2009): State Of Food and Insecurity (SOFI) 2009. FAO Rome.

FAO (2011): FAO initiative on soaring food prices: Guide for policy and programmatic actions at country level to address high food prices, FAO UN Rome.

FAO UN (2008): Formation participative sur les bonnes pratiques agricoles dans les systèmes de production coton-céréales-élevage. Rapport final de la campagne 2007-2008 FAO-AGPP, Rome ; UNCPB –INERA, Burkina Faso; March 2008. Unpublished.

Fei, J. C. H., and Ranis, G. (1964), *Development of the Labour Surplus Economy,* Homewood: Irwin, 1964

Garcia-Torres, L., Benites, J., Martinez-Vilela, A. and Holgado-Cabrera, A.,(2003). (Eds.) Conservation Agriculture: Environment, Farmers Experiences, Innovations, Socio-Economy, Policy. Kluwer Academic Publishers, The Netherlands.

Gibson. K. (2003) Armington Elasticities for South Africa. Long and Short Run level Estimates. Trade and Industrial Policy Strategies Working paper 12-2003 University of Natal (South Africa).

Harris, J. R., and Todaro, (1970) M . P., 'Migration, Unemployment and Development: a two-sector analysis', *The American Economic Review,* 60 (1) , Mar. 1970, pp. 126-42.

Hebie, Mamadou (2007). Social Accounting Matrix of Burkina Faso, year 2000. Unpublished. Direction Générale des Statistiques et Prévisions Agricoles. Ministère de l'Agriculture, de l'Hydraulique et des Ressources Halieutiques (MAHRH). Ouagadougou. This is the only SAM available to date and was prepared in the context of a policy assistance project supported by FAO.

Hirschman, A., O. (1958): The strategy of Economic Development, Yale University Press, New Haven, Connecticut.

IMF (2007).The IMF and Aid to Sub‐Saharan Africa. Evaluation report, p.48. Independent Evaluation Office of the IMF. Whashington D.C. USA

INSD (2003) Analyse des résultats de l'Enquête sur les Conditions de vie des ménages Burkina Faso. Ministère de l'Economie et du développement. Segretariat General, Insitut National de la Statistique et de la Démographie (INSD)

INSD (2003) : Profile de la Pauvreté en 2003. Ministère de l'Economie et du développement. Segretariat General, Insitut National de la Statistique et de la Démographie (INSD)

Johnston B,F and Mellor J,W. (1961): The role of agriculture in economic development, American Economic Review 51(4): 566-593, 1961. Anríquez, G., Stamoulis, K. 2007. Rural development and poverty reduction: Is Agriculture Still a Key? e-JADE, FAO- Rome.

Jorgenson D., W. (1967) Surplus Agricultural Labour and the Development of a Dual Economy, *Oxford Economic Papers.*1967; 19: 288-312

Lofgren H, Lee Harris R, Robinson S. et al.(2002) A standard Computable General Equilibrium (CGE) model in GAMS. International Food Policy Research Institute, Washington D.C.

MECV (2008). Rapport sur la filière Pêche. Ministère de l'Environnement et du Cadre de Vie. Ouagadougou Burkina Faso.

MEF (2011) Stratégie pour la croissance accélérée et le développement durable 2011-2015 (Unpublished). Ministère de l'Economie et des Finances, Burkina Faso.

Mundlak**,** Y. (2000). *Agriculture and Economic Growth* Theory and Measurement. Harvard University Press.

Round J. (2003): Social Accounting Matrices and SAM-based multiplier analysis", chapter 14 in F. Bourguignon and L.A Pereira da Silva (Eds): The impact of economic policies on poverty and income distribution, New York, World Bank and Oxford University Press.

Setboonsarng S. 2006 Organic Agriculture, Poverty Reduction, and the Millennium Development Goals August 2006 Asian Development Bank Institute (ADBI).

Sundberg, M, and Lofgren, H. (2005). Absorptive capacity and achieving the MDGs: The case of Ethiopia. In Peter Isard, Leslie Lipschitz, Alexandros Mourmouras, and Peter Heller (eds). *Macroeconomic Management of Foreign Aid: Opportunities and Pitfalls*. International Monetary Fund, Washington, DC.

Taylor L. (2004). Reconstructing macroeconomics: structuralist proposals and critiques of the mainstream Ch 10. Harvard University Press, 2004.

The Economist (1977). "The Dutch Disease", November 26, 1977. pp. 82-83.

United Nations Development Group, Millennium Development Goals (MDGs): *http://www.undg.org.*

World Bank (2004): Global monitoring report. Policies and Actions for Achieving the Millennium Development Goals and Related Outcomes. World Bank, Washington, D.C.
World Bank (2005): 2005 Review of the PRS Approach: Balancing Accountabilities and Scaling Up Results. World Bank, Washington D.C.

11. Appendix A: Detailed data and tables

Table A1 Consumer Prices (composite domestic-import prices) under different international price shock scenarios

	Base	Food	Oil	Fertilizer	Cotton	Joint
Cotton grains	1.000	-0.3%	3.3%	1.5%	1.0%	5.8%
Cash crops	1.033	2.0%	4.2%	6.1%	0.8%	16.0%
Vegetables	1.000	-0.3%	1.5%	6.5%	-1.8%	5.8%
Food crops	1.002	0.1%	0.4%	10.7%	0.7%	14.6%
Other Agriculture	1.002	0.3%	0.4%	7.9%	0.6%	11.3%
Livestock-bovine	1.001	0.0%	-5.0%	-1.2%	-2.2%	-12.4%
Other livestock	1.002	-0.3%	-6.9%	-1.4%	-2.0%	-14.8%
Hunting	1.000	-0.4%	-6.7%	-1.5%	-0.8%	-12.5%
Forestry	1.000	-0.4%	-6.6%	-1.5%	-0.7%	-12.2%
Fisheries	1.000	-0.4%	-6.6%	-1.5%	-0.7%	-12.2%
Mining	1.017	-0.9%	-6.9%	-2.2%	-3.5%	-27.7%
Cotton ginning	1.000	2.0%	-25.4%	-4.3%	137.6%	90.7%
Slaugthering	1.003	-1.1%	-21.2%	-5.3%	-7.4%	-39.9%
Agro-industry	1.057	2.4%	-7.7%	-1.3%	1.2%	-9.8%
Fertilizers and Pesticides	1.000	-0.8%	0.2%	126.5%	9.1%	166.7%
Other industry	1.110	-0.9%	2.0%	0.2%	7.3%	10.8%
Oil and oil products	1.000	-1.1%	116.1%	-0.9%	6.6%	154.5%
Power, water and gas	1.056	-1.0%	23.5%	-2.1%	-0.7%	27.2%
Trade	1.000	-0.8%	3.9%	-2.2%	-4.3%	-6.9%
Transport	1.028	-1.0%	8.5%	-1.1%	1.9%	12.1%
Financial services	1.189	-1.0%	-15.2%	-3.3%	-5.7%	-31.3%
Services to enterprises	1.023	-0.9%	-16.0%	-3.4%	-4.7%	-30.2%
Services to households	1.000	-0.9%	-9.0%	-3.0%	-5.5%	-21.7%

Source: CGE model output

Table A2. Yields, cost structure and value added for maize and cotton under ordinary and GAP technologies.

	Mais			Cotton		
	Current	GAP	Var %	Current	GAP	Var %
Yield (Kg/Ha)	1,617	3,047	88.5%	1,229	1,777	44.7%
Revenue	100.0	100.0	0.0%	100.0	100.0	0.0%
Interm.Cons.	51.5	41.7	-18.9%	55.8	45.9	-17.7%
Chemicals	*45.9*	*28.4*	*-38.0%*	*53.8*	*31.7*	*-41.1%*
Other inputs	*5.6*	*13.3*	*138.0%*	*2.0*	*14.2*	*606.9%*
Value added	48.5	58.3	20.1%	44.2	54.1	22.4%

Source: Author's calculations on data reported in FAO UN (2008).

Table A3 Consumer Prices (composite domestic-import prices) under different technologies and international price shock scenarios.

	Base	Food	Oil	Fertilizer	Cotton	Joint
Cotton grains	1.000	-0.3%	3.3%	1.5%	1.0%	5.8%
Cash crops	1.033	2.0%	4.2%	6.1%	0.8%	16.0%
Vegetables	1.000	-0.3%	1.5%	6.5%	-1.8%	5.8%
Food crops	1.002	0.1%	0.4%	10.7%	0.7%	14.6%
Other Agriculture	1.002	0.3%	0.4%	7.9%	0.6%	11.3%
Livestock-bovine	1.001	0.0%	-5.0%	-1.2%	-2.2%	-12.4%
Other livestock	1.002	-0.3%	-6.9%	-1.4%	-2.0%	-14.8%
Hunting	1.000	-0.4%	-6.7%	-1.5%	-0.8%	-12.5%
Forestry	1.000	-0.4%	-6.6%	-1.5%	-0.7%	-12.2%
Fisheries	1.000	-0.4%	-6.6%	-1.5%	-0.7%	-12.2%
Mining	1.017	-0.9%	-6.9%	-2.2%	-3.5%	-27.7%
Cotton ginning	1.000	2.0%	-25.4%	-4.3%	137.6%	90.7%
Slaugthering	1.003	-1.1%	-21.2%	-5.3%	-7.4%	-39.9%
Agro-industry	1.057	2.4%	-7.7%	-1.3%	1.2%	-9.8%
Fertilizers and Pesticides	1.000	-0.8%	0.2%	126.5%	9.1%	166.7%
Other industry	1.110	-0.9%	2.0%	0.2%	7.3%	10.8%
Oil and oil products	1.000	-1.1%	116.1%	-0.9%	6.6%	154.5%
Power, water and gas	1.056	-1.0%	23.5%	-2.1%	-0.7%	27.2%
Trade	1.000	-0.8%	3.9%	-2.2%	-4.3%	-6.9%
Transport	1.028	-1.0%	8.5%	-1.1%	1.9%	12.1%
Financial services	1.189	-1.0%	-15.2%	-3.3%	-5.7%	-31.3%
Services to enterprises	1.023	-0.9%	-16.0%	-3.4%	-4.7%	-30.2%
Services to households	1.000	-0.9%	-9.0%	-3.0%	-5.5%	-21.7%

	Base	Reduced Chemicals	Reduced Int.Inputs	Increased Factors	Joint GAP changes	Shocks + GAP
Cotton grains	1.000	-0.2%	-7.9%	12.6%	5.0%	10.6%
Cash crops	1.033	-1.4%	-9.0%	12.2%	2.9%	14.9%
Vegetables	1.000	-1.4%	-13.1%	6.5%	-6.6%	-1.7%
Food crops	1.002	-2.6%	-5.6%	14.5%	7.7%	17.1%
Other Agriculture	1.002	-1.9%	-4.8%	15.2%	9.5%	17.2%
Livestock-bovine	1.001	0.3%	1.2%	-1.1%	0.2%	-10.5%
Other livestock	1.002	0.3%	1.2%	-1.0%	0.4%	-12.6%
Hunting	1.000	0.3%	1.6%	-0.7%	1.0%	-10.3%
Forestry	1.000	0.3%	1.6%	-0.7%	1.0%	-10.1%
Fisheries	1.000	0.3%	1.6%	-0.7%	1.0%	-10.1%
Mining	1.017	0.6%	0.0%	-6.1%	-5.5%	-29.2%
Cotton ginning	1.000	0.9%	-15.0%	38.1%	17.3%	136.8%
Slaugthering	1.003	1.2%	5.7%	-5.1%	0.8%	-36.8%
Agro-industry	1.057	0.3%	0.4%	-1.6%	-1.0%	-9.1%
Fertilizers and Pesticides	1.000	-9.7%	-9.4%	-2.8%	-12.1%	151.0%
Other industry	1.110	0.1%	-2.2%	-0.6%	-2.3%	7.7%
Oil and oil products	1.000	0.3%	2.6%	0.1%	2.7%	149.0%
Power, water and gas	1.056	0.5%	2.6%	-4.2%	-1.7%	25.0%
Trade	1.000	1.1%	-6.0%	-8.0%	-12.9%	-13.0%
Transport	1.028	0.3%	0.5%	-3.0%	-2.3%	9.7%
Financial services	1.189	0.7%	3.6%	-6.7%	-3.1%	-31.0%
Services to enterprises	1.023	0.7%	3.2%	-6.1%	-2.7%	-29.8%
Services to households	1.000	0.6%	3.7%	-7.1%	-3.7%	-22.4%

Source: CGE model output

Table A4 activity levels under different price shock and technology scenarios

	Base	Food	Oil	Fertilizer	Cotton	Joint
Cotton grains	58,637	-2.5%	53.7%	6.4%	-66.1%	-57.2%
Cash crops	37,730	1.9%	-12.5%	-8.8%	3.7%	-18.0%
Vegetables	27,900	-0.2%	-7.9%	-4.0%	-1.5%	-15.5%
Food crops	147,770	0.1%	-8.7%	-5.9%	-2.2%	-18.7%
Other Agriculture	42,897	0.5%	-7.9%	-4.7%	-0.8%	-14.6%
Livestock-bovine	111,708	-0.3%	-4.1%	-0.9%	-0.1%	-8.0%
Other livestock	109,470	-0.2%	-4.6%	-1.0%	-0.7%	-9.1%
Hunting	8,025	-0.4%	-8.4%	-1.8%	-2.8%	-16.9%
Forestry	49,636	-0.3%	-5.2%	-0.6%	0.9%	-4.3%
Fisheries	8,896	-0.3%	-7.5%	-1.7%	-2.6%	-15.4%
Mining	13,640	-0.1%	13.2%	4.4%	23.0%	99.0%
Cotton ginning	76,146	-2.7%	57.3%	6.9%	-70.6%	-61.1%
Slaugthering	119,992	-0.1%	-3.3%	-0.7%	-0.8%	-10.5%
Agro-industry	257,294	0.9%	-2.9%	-1.0%	0.5%	-4.5%
Other industry	232,837	-0.1%	2.8%	1.5%	7.5%	20.2%
Power, water and gas	51,129	-0.1%	-7.8%	-0.8%	-2.6%	-13.7%
Trade	255,150	0.0%	2.6%	0.1%	-0.6%	2.9%
Transport	93,443	0.0%	-2.8%	0.6%	1.8%	-0.6%
Financial ervices	34,637	-0.2%	-2.7%	-0.6%	-1.0%	-8.1%
Services to enterprises	672,900	-0.1%	-2.1%	-0.3%	-0.2%	-3.9%
Services to households	413,041	0.0%	-0.3%	0.0%	0.0%	-0.5%

Aggregated activity levels

	Food	Oil	Fertilizer	Cotton	Joint	Base	% base
Cotton grains+ginning	-2.6%	55.7%	6.7%	-68.7%	-59.4%	134,783	4.8%
Other agriculture	0.4%	-9.0%	-5.9%	-1.0%	-17.6%	256,296	9.1%
Livestock, forestry, fishing	-0.2%	-4.3%	-0.9%	-0.5%	-8.9%	407,728	14.4%
Other agroindustry	0.9%	-2.9%	-1.0%	0.5%	-4.5%	257,294	9.1%
Other Industry	-0.1%	3.3%	1.7%	8.3%	24.6%	246,477	8.7%
Services	0.0%	-1.1%	-0.1%	-0.2%	-2.1%	1,520,299	53.9%
total						2,822,877	100.0%

	Base	Reduced Chemicals	Reduced Int.Inputs	Increased Factors	Joint GAP changes	Shocks + GAP
Cotton grains	58,637	1.8%	14.1%	-29.3%	-16.8%	-63.4%
Cash crops	37,730	4.2%	9.8%	-13.3%	-4.0%	-16.9%
Vegetables	27,900	1.4%	7.0%	-3.5%	2.9%	-12.5%
Food crops	147,770	2.1%	4.3%	-6.3%	-1.9%	-17.2%
Other Agriculture	42,897	2.0%	3.6%	-6.7%	-3.0%	-14.4%
Livestock-bovine	111,708	0.3%	0.8%	-0.6%	0.4%	-6.5%
Other livestock	109,470	0.4%	1.0%	-0.9%	0.3%	-7.7%
Hunting	8,025	0.7%	1.8%	-1.9%	0.3%	-15.1%
Forestry	49,636	0.0%	1.0%	0.1%	1.2%	-3.4%
Fisheries	8,896	0.7%	1.7%	-1.6%	0.4%	-13.5%
Mining	13,640	-2.4%	-2.3%	12.3%	8.2%	97.4%
Cotton ginning	76,146	1.9%	15.1%	-31.3%	-17.9%	-67.7%
Slaugthering	119,992	0.2%	0.7%	-0.4%	0.5%	-7.7%
Agro-industry	257,294	0.3%	1.1%	-0.1%	1.3%	-2.7%
Other industry	232,837	-1.1%	-0.1%	4.4%	3.7%	20.5%
Power, water and gas	51,129	0.4%	0.8%	-0.8%	0.2%	-12.9%
Trade	255,150	0.0%	-2.3%	-0.7%	-2.8%	0.5%
Transport	93,443	-0.2%	-1.4%	1.1%	-0.2%	-1.3%
Financial Services	34,637	0.2%	0.4%	0.3%	1.0%	-6.2%
Services to enterprises	672,900	0.1%	0.2%	0.1%	0.4%	-3.2%
Services to households	413,041	0.0%	0.0%	0.0%	0.1%	-0.4%

Aggregated activity levels

	Reduced Chemicals	Reduced Int.Inputs	Increased Factors	Joint GAP changes	Shocks + GAP	Joint price shocks	Base	% base
Cotton grains+ginning	1.9%	14.7%	-30.4%	-17.4%	-65.8%	-59.4%	134,783	4.8%
Other agriculture	2.3%	5.3%	-7.1%	-1.9%	-16.2%	-17.6%	256,296	9.1%
Livestock, forestry, fishing	0.3%	0.9%	-0.6%	0.5%	-7.1%	-8.9%	407,728	14.4%
Other agroindustry	0.3%	1.1%	-0.1%	1.3%	-2.7%	-4.5%	257,294	9.1%
Other Industry	-1.2%	-0.2%	4.8%	3.9%	24.8%	24.6%	246,477	8.7%
Services	0.0%	-0.3%	0.0%	-0.3%	-2.1%	-2.1%	1,520,299	53.9%
total							2,822,877	100.0%

12. Appendix B: features of the CGE model adopted

12.1. The LES demand system

As final demand functions, the model uses a Linear Expenditure System (LES), based on the Stone-Geary utility function.
Demand functions for each commodity c are as follows:

$$p_i c_i = p_i \gamma_i + \beta_i \left[Y - \sum_j p_j \gamma_j \right]$$

where parameters γ_i may be thought of as representing the purchase of "subsistence quantities" of every good c, and the term in square brackets as "supernumerary" expenditures (remaining resources after having purchased subsistence quantities) to be divided among goods on the basis of a fixed proportion (parameters β_i). Note that the β_i are the marginal expenditure shares, which tell how much the expenditure share of a commodity changes, as expenditure changes (the first derivative of the expenditure on c w.r.t. *Y*)

Note that the major attractiveness of this system is that it is the only theoretical consistent demand function for which demand for every good is a linear function of all prices and expenditures. Unfortunately, Engel curves are linear, which is somehow not realistic.

In the model, the user provides the following data:

1. expenditure by commodity per type of household (from the SAM), to calculate expenditure shares
2. Expenditure elasticities
3. The FRISCH parameter , the so called “flexibility of money” i.e. the elasticity of the marginal utility of income wrt the income (how the marginal utility of income changes for an 1% increase of income) (See FRISCH, Econometrica 1959)

The model works out the betas and gammas, to be then used in the demand functions, using the links among LES parameters of the demand functions, and expenditure elasticities, expenditure shares and FRISH parameter (for formulae about these links see e.g. Sadoulet, De Janvry 1995 p. 42).

Calculation of Betas

In the model the parameters beta are calculated as follows:

*betam(C,H) = BUDSHR(C,H)*LESELAS1(C,H);*

Note that for LES holds: $\eta_i = \frac{\beta_i}{w_i}$, i.e the expenditure elasticity of commodity C equals the ratio of the beta parameter of the demand function and the expenditure share for commodity C, as derived here below:

$$c_i = \gamma_i + \frac{\beta_i}{p_i}\left[Y - \sum_j p_j \gamma_j\right]$$

$$\eta_i = \frac{\partial c_i}{\partial Y}\frac{Y}{c_i}$$

$$\frac{\partial c_i}{\partial Y} = \frac{\beta_i}{p_i}$$

$$\eta_i = \frac{\beta_i}{p_i}\frac{Y}{c_i}.$$

Nothing that $\frac{Y}{p_i c_i} = \frac{1}{w_i}$ i.e. the inverse of the expenditure share for Ci, we get:

$$\eta_i = \frac{\beta_i}{w_i}$$

This implies therefore: $\beta_i = \eta_i w_i$, which is the formula applied in the model:

Calculation of the subsistence consumptions gammas

In the model the subsistence consumption for each (marketed)commodity γ_i and for each household type H, is calculated as:

gammam0(C,H)$BUDSHR(C,H)
= ((SUM(CP, SAM(CP,H)) + SUM(AP, SAM(AP,H))) / PQ0(C))
** (BUDSHR(C,H) + betam(C,H)/FRISCH(H));*

- the dollar condition *$BUDSHR(C,H)* to be interpreted "...for all the commodities whose budget share is different from zero (the "*NE 0*" i.e. "not equal to 0" is omitted because it is the default)
- The sum of the two summations in the RHS: *(SUM(CP, SAM(CP,H)) + SUM(AP, SAM(AP,H)))* represents the total expenditure *Y*.
- *PQ0(C)* is the price of commodity *i*, p_i (at the benchmark)
- *BUDSHR(C,H)* is the budget share for commodity C in household H, i.e. $\frac{p_i c_i}{Y}$
- *betam(C,H)* is the other LES parameter defined above;
- *FRISCH(H)* is the FRISCH parameter for the household type H

- For the home consumption the same apply.

The *gammam0* parameter is directly derived by the demand function of the LES for each commodity C, i.e. and from the definition of the FRISCH parameter. On the basis of the fact that the LES is based on a pointwise separable utility function (i.e. the marginal utility of one good does not depend on the level of consumption of other goods), the FRISCH parameter in the LES is[219]:

$$\omega = -\frac{Y}{Y - \sum_j p_j \gamma_j} \quad \Rightarrow \quad \sum_j p_i \gamma_i = \frac{Y}{\omega} + Y$$

Substituting to the summation in the demand function:

$$p_i c_i = p_i \gamma_i + \beta_i \left[Y - \frac{Y}{\omega} + Y \right]$$

and working out the parameter γ_i gives:

$$\gamma_i = \frac{p_i c_i}{p_i} + \frac{\beta_i Y}{p_i \omega}$$

$$\gamma_i = c_i + \frac{\beta_i Y}{p_i \omega}$$

Alternatively, multiplying both numerator and denominator of the first term in the RHS by *Y* gives:

$\gamma_i = \frac{p_i c_i Y}{p_i Y} + \frac{\beta_i Y}{p_i \omega} \Rightarrow \gamma_i = \frac{Y}{p_i}\left[\frac{p_i c_i}{Y} + \frac{\beta_i Y}{p_i \omega} \right]$ and noting that $\frac{p_i c_i}{Y}$ is the budget share for commodity C, w_i , we get:

$\gamma_i = \frac{Y}{p_i}\left[w_i + \frac{\beta_i Y}{p_i \omega} \right]$ which is the formula used in the model.

[219] See e.g. Sadoulet, De Janvry 1995 p. 42.

Own and Cross-price elasticities of LES in the CGE model

In the model, own and cross-price elasticities are calculated on the basis of expenditure elasticities and the parameters beta and gamma of the LES demand functions worked out above.

Own-price elasticities.
The model calculates in a similar way own-price elasticities for both marketed commodities of non-marketed commodities, say, home consumption, for different types of households H. For example, the own price elasticities for the marketed commodities are calculated as follows:

LESELASP(H,'MRK',C,'MRK',C) =
-LESELAS1(C,H)(PQ0(C)* gammam(C,H) / (SUM(CP, SAM(CP,H)) +*
SUM(AP, SAM(AP,H))) - 1/FRISCH(H));

Note that:

(SUM(CP, SAM(CP,H)) + SUM(AP, SAM(AP,H))) corresponds to the total expenditure *Y.*

The model makes use of the own-price elasticity formula[220]:

$$\eta_{(i,i)} = -\eta_i \left[\frac{\gamma_i p_i}{y} - \frac{1}{\omega} \right]$$

In general, the LES elasticities are derived as follows. We suppose a two-good case and then generalise the result to n-good case.

$$c_1 = \gamma_1 + \frac{\beta_1}{p_1}\left[Y - p_1\gamma_1 - p_2\gamma_2\right]$$

$$\eta_{(1,1)} = \frac{\partial c_1}{\partial p_1}\frac{p_1}{c_1}$$

$$\frac{\partial c_1}{\partial p_1} = \frac{\beta_1}{p_1^2}\left[p_2\gamma_2 - Y\right]$$

$$\eta_{(1,1)} = \frac{\beta_1}{p_1^2}\left[p_2\gamma_2 - Y\right]\frac{p_1}{c_1}$$

After rearranging we get:

[220] This formula is provided in K. Dervis, J. De Melo, Robinson (1982): General Equilibrium models for development policy. World Bank Research Publication. Cambridge University Press.

$$\eta_{(1,1)} = \frac{\beta_1[p_2\gamma_2 - Y]}{p_1 c_1}$$ Adding and subtracting 1:

$$\eta_{(1,1)} = \frac{\beta_1[p_2\gamma_2 - Y]}{p_1 c_1} + 1 - 1$$

$$\eta_{(1,1)} = \frac{\beta_1[p_2\gamma_2 - Y] + p_1 c_1}{p_1 c_1} - 1$$ Recalling that, from the demand function:

$p_1 c_1 = p_1\gamma_1 + \beta_1(Y - p_1\gamma_1 - p_2\gamma_2)$ and substituting in the numerator:

$$\eta_{(1,1)} = \frac{\beta_1(p_2\gamma_2 - Y) + p_1\gamma_1 + \beta_1(Y - p_1\gamma_1 - p_2\gamma_2)}{p_1 c_1} - 1.$$ From which:

$$\eta_{(1,1)} = \frac{\beta_1 p_2\gamma_2 - \beta_1 Y + p_1\gamma_1 + \beta_1 Y - \beta_1 p_1\gamma_1 - \beta_1 p_2\gamma_2}{p_1 c_1} - 1.$$

$$\eta_{(1,1)} = \frac{+ p_1\gamma_1 - \beta_1 p_1\gamma_1}{p_1 c_1} - 1$$

$$\eta_{(1,1)} = \frac{(1-\beta_1) p_1\gamma_1}{p_1 c_1} - 1.$$

Cleaning p and generalising to the n-commodity case[221]:

$$\eta_{(i,i)} = \frac{\gamma_i(1-\beta_i)}{c_i} - 1.$$

The model applies a different rearrangement of this formula, derived as follows:

$$\eta_{(i,i)} = \frac{\gamma_i(1-\beta_i)}{c_i} - 1$$

$$\eta_{(i,i)} = \frac{\gamma_i - c_i - \gamma_i\beta_i}{c_i}$$

Recall from the demand function that:

$$\gamma_i - c_i = -\frac{\beta_i}{p_i}\left[Y - \sum_j p_i\gamma_i\right]$$

Substituting into the numerator, leads to:

[221] This is the same formula reported in Sadoulet and de Janvry (1995)

$$\eta_{(i,i)} = \frac{-\frac{\beta_i}{p_i}\left[Y - \sum_j p_i\gamma_i\right] - \gamma_i\beta_i}{c_i}$$ rearranging, we get :

$$\eta_{(i,i)} = \frac{-\beta_i\left[Y - \sum_j p_i\gamma_i\right]}{p_i c_i} - \frac{\gamma_i\beta_i}{c_i}$$ multiplying and dividing both RHS terms by Y :

$$\eta_{(i,i)} = \frac{-\beta_i\left[Y - \sum_j p_i\gamma_i\right]Y}{p_i c_i Y} - \frac{\gamma_i\beta_i Y}{c_i Y}$$ and recalling that :

$$\frac{-\left[Y - \sum_j p_i\gamma_i\right]}{Y} = \frac{1}{\omega}$$ i.e. the inverse of the LES Frisch parameter, and substituting :

$$\eta_{(i,i)} = \frac{\beta_i Y}{p_i c_i \omega} - \frac{\gamma_i\beta_i Y}{c_i Y}$$

Recall also that the partial derivative of the LES demand functions, w.r.t. the total expenditure is [222]:

$$\frac{\partial c_i}{\partial y} = \frac{\beta_i}{p_i}$$ and substituting in the above leads to:

$$\frac{\partial c_i}{\partial Y} = \frac{\beta_i}{p_i}$$

$$\eta_{(i,i)} = \frac{\partial c_i}{\partial Y}\frac{Y}{c_i}\frac{1}{\omega} - \frac{\partial c_i}{\partial Y}\frac{Y}{c_i}\frac{\gamma_i p_i}{Y}$$ and noting that $\frac{\partial c_i}{\partial Y}\frac{Y}{c_i} = \eta_i$, i.e. the expenditure elasticity of Ci, this implies:

$$\eta_{(i,i)} = \eta_i\frac{1}{\omega} - \eta_i\frac{\gamma_i p_i}{y}$$

$$\eta_{(i,i)} = -\eta_i\left[\frac{\gamma_i p_i}{Y} - \frac{1}{\omega}\right]$$

After rearranging:

$$\eta_{(i,i)} = -\eta_i\left[\frac{\gamma_i p_i}{Y} - \frac{1}{\omega}\right]$$

which is the formula for the own price elasticity provided in Dervis et al (1982) and used in the model.

[222] In the LES, the betas are the marginal budget shares, i.e. the change in the budget allocated to each commodity Ci for a change in the total expenditure. This is easily verifiable by differentiating the demand function for Ci in value form w.r.t. the total expenditure y

Cross price elasticities in LES

The model calculates cross-price elasticities in a similar way for both marketed commodities of non-marketed commodities, say, home consumption, for different types of households H. For example, the cross price elasticities for the marketed commodities with the other marketed commodities are calculated as follows[223]:

```
LESELASP(H,'MRK',C,'MRK',CP)
   $((ORD(C) NE ORD(CP)) AND LESELAS1(C,H) AND LESELAS1(CP,H))
 = -LESELAS1(C,H)
   * PQ0(CP)*gammam(CP,H) / (SUM(CPP, SAM(CPP,H)) + SUM(APP,
SAM(APP,H)));
```

In mathematical notation (after dropping the household index H, the formula is the following

$$\eta_{(i,j)} = \frac{-\eta_i p_j \gamma_j}{Y}$$

The formula is derived as follows:

$$c_1 = \gamma_1 + \frac{\beta_1}{p_1}\left[Y - p_1\gamma_1 - p_2\gamma_2\right]$$

$$\eta_{(1,2)} = \frac{\partial c_1}{\partial p_2}\frac{p_2}{c_1}$$

$$\frac{\partial c_1}{\partial p_2} = -\frac{\beta_1}{p_1}\gamma_2$$

$$\eta_{(1,2)} = -\frac{\beta_1 p_2 \gamma_2}{p_1 c_1}$$

Generalising to the n-case[224]:

$$\eta_{(i,j)} = \frac{-\beta_i p_j \gamma_j}{c_i p_i}$$

Noting that: $\beta_i = p_i \frac{\partial c_i}{\partial Y}$ as it can be easily verified differentiating the demand function w.r.t. Y, and substituting into the numerator:

$\eta_{(i,j)} = \frac{\partial c_i}{\partial Y}\frac{p_j \gamma_j p_i}{c_i p_i}$ Cleaning up Pi and multiplying both numerator and denominator by Y, we get:

$$\eta_{(i,j)} = \frac{\partial c_i}{\partial Y}\frac{Y}{c_i}\frac{p_j \gamma_j}{Y}$$

[223] The

[224] The same formula is provided e.g. in Sadoulet, De Janvry (1995)

Recalling the definition of the expenditure elasticity for commodity Ci:

$$\eta_i = \frac{\partial c_i}{\partial Y}\frac{Y}{c_i}$$

and substituting it in to the formula above, leads to:

$$\eta_{(i,j)} = \frac{-\eta_i p_j \gamma_j}{Y}$$ which is the formula used in the model[225].

12.2. Armington functions for imported goods

For all the commodities C which are both imported (Qm > 0) and produced domestically (Qd > 0) the model utilises a Constant Elasticity of Substitution (CES) function in order to aggregate domestic production and imports to create a "minimum cost" composite commodity Qq[226]. Therefore, the problem for the economy is to choose the appropriate mix of Qm and Qd which minimizes the cost of a given quantity Qq, knowing that Qq is linked to QM and QD by the CES "production" function[227].

$$\underset{QM,QD}{Min}\ Pq\overline{Qq} = PmQm + PdQd$$

$$\text{s.t. } Qq = \alpha\left[\delta Qm^{-\rho_c} + (1-\delta)Qd^{-\rho_c}\right]^{-\frac{1}{\rho_c}}$$

Using the method of Lagrange multipliers, the minimization problem amounts to:

$$\underset{Qm,Qd,\lambda}{Min\ L} = PmQm + PdQd - \lambda\left\{\alpha\left[\delta Qm^{-\rho} + (1-\delta)Qd^{-\rho}\right]^{-\frac{1}{\rho}} - Qq\right\}$$

The first order partial derivatives of the lagrangean are:

$$\frac{\partial \mathrm{L}}{\partial Qm} = Pm - \frac{\partial\lambda\{...\}}{\partial\{...\}}\frac{\partial\{...\}}{\partial Qm} = Pm - \lambda\alpha\left(-\frac{1}{\rho}\right)[...]^{\frac{\rho-1}{\rho}}(-\rho)\delta Qm^{-(\rho+1)}$$

[225] As also provided in Dervis et Al. (1982).

[226] The CES function was originally introduced by K.J. Arrow, H.B. Chenery, B.S. Minhas and R.M. Solow (1961): Capital-Labour Substitution and Economic Efficiency, Review of Economics and Statistics, August 1961 pp 225-50.

[227] The objective function of the minimization problem enters in the CGE model as the equation of the "absorption" for each commodity C which is both produced domestically and imported. This equation provides the total value of the composite commodity C absorbed by the economic system. Note that, dividing both sides of the equation by Qq, the equation provides the price of the composite commodity C as the weighted sum of prices Pd and Pm, where the weights are the shares of Qm and Qd with respect to Qq.

$$\frac{\partial \mathrm{L}}{\partial Qd} = Pd - \frac{\partial \lambda\{....\}}{\partial\{...\}}\frac{\partial\{....\}}{\partial Qd} = Pd - \lambda\alpha\left(-\frac{1}{\rho}\right)[....]^{\frac{\rho-1}{\rho}}(-\rho)(1-\delta)Qd^{-(\rho+1)}$$

$$\frac{\partial \mathrm{L}}{\partial \lambda} = \alpha[...]^{-\frac{1}{\rho}} - Qq$$

The first order conditions amount to:

$$Pm - \lambda\alpha\left(-\frac{1}{\rho}\right)[....]^{\frac{\rho-1}{\rho}}(-\rho)\delta Qm^{*-(\rho+1)} = 0 \Rightarrow Pm = \lambda\alpha\left(-\frac{1}{\rho}\right)[....]^{\frac{\rho-1}{\rho}}(-\rho)\delta Qm^{*-(\rho+1)}$$

$$Pd - \lambda\alpha\left(-\frac{1}{\rho}\right)[....]^{\frac{\rho-1}{\rho}}(-\rho)(1-\delta)Qd^{*-(\rho+1)} = 0 \Rightarrow Pd = \lambda\alpha\left(-\frac{1}{\rho}\right)[....]^{\frac{\rho-1}{\rho}}(-\rho)(1-\delta)Qd^{*-(\rho+1)}$$

$$\alpha\left[\delta Qm^{*-\rho} + (1-\delta)Qd^{*-\rho}\right]^{-\frac{1}{\rho}} - Qq = 0 \Rightarrow \alpha\left[\delta Qm^{*-\rho} + (1-\delta)Qd^{*-\rho}\right]^{-\frac{1}{\rho}} = Qq$$

This implies that, taking the ratio of the first two first order conditions:

$$\frac{Pm}{Pd} = \frac{\lambda\alpha\left(-\frac{1}{\rho}\right)[....]^{\frac{\rho-1}{\rho}}(-\rho)\delta Qm^{*-(\rho+1)}}{\lambda\alpha\left(-\frac{1}{\rho}\right)[....]^{\frac{\rho-1}{\rho}}(-\rho)(1-\delta)Qd^{*-(\rho+1)}} \Rightarrow \frac{Pm}{Pd} = \frac{\delta}{(1-\delta)}\left[\frac{Qm^*}{Qd^*}\right]^{-(\rho+1)}$$

Here, the import-domestic price ratio is expressed as a function of the import-domestic demand ratio. We can then work out the import-domestic demand ratio as a function of the domestic-import price ratio:

$$\frac{(1-\delta)}{\delta}\frac{Pm}{Pd} = \left[\frac{Qm^*}{Qd^*}\right]^{-(\rho+1)} \Rightarrow \frac{Qm^*}{Qd^*} = \left[\frac{(1-\delta)}{\delta}\frac{Pm}{Pd}\right]^{\frac{-1}{(\rho+1)}} \Rightarrow \frac{Qm^*}{Qd^*} = \left[\frac{\delta}{(1-\delta)}\frac{Pd}{Pm}\right]^{\frac{1}{(\rho+1)}}$$

The import-domestic demand ratio expressed as a function of the domestic-import price ratio enter, together with the CES Composite supply function (the Armington function) and the price function of the composite commodity, as expressed by the objective function of the minimisation problem, into the set of equations of the model[228].

Note that, as the production function constraining the cost minimisation problem is a CES, the elasticity of the import-domestic demand ratio with respect to the domestic-

[228] Note that, if the prices Pm and Pd are assumed exogenous as well as the quantity of composite commodity to be obtained Qq, these three equations determine the three endogenous variables Qm Qd and Pq, i.e. the optimal quantities of "inputs" Qm and Qd to obtain a given quantity of "output" Qq at the minimum cost Pq.

import price ratio is constant (i.e. does not depend upon the level of the demand or price ratios). It is expressed by:

$$\varepsilon_{\frac{Qm^*}{Qd^*},\frac{Pd}{Pm}} = \frac{\partial \frac{Qm^*}{Qd^*}}{\partial \frac{Pd}{Pm}} \frac{\frac{Pd}{Pm}}{\frac{Qm^*}{Qd^*}} = \frac{1}{(\rho+1)} \left[\frac{\delta}{(1-\delta)}\right]^{\frac{1}{(\rho+1)}} \left[\frac{Pd}{Pm}\right]^{\frac{1}{(\rho+1)}-1} \frac{Pd}{Pm} \left[\frac{\delta}{(1-\delta)}\right]^{\frac{-1}{(\rho+1)}} \left[\frac{Pd}{Pm}\right]^{\frac{-1}{(\rho+1)}}$$

$$\frac{\partial \frac{Qm^*}{Qd^*}}{\partial \frac{Pd}{Pm}} \frac{\frac{Pd}{Pm}}{\frac{Qm^*}{Qd^*}} = \frac{1}{(\rho+1)} \left[\frac{\delta}{(1-\delta)}\right]^{\frac{1}{(\rho+1)}} \left[\frac{Pd}{Pm}\right]^{\frac{1}{(\rho+1)}-1} \frac{Pd}{Pm} \left[\frac{\delta}{(1-\delta)}\right]^{\frac{-1}{(\rho+1)}} \left[\frac{Pd}{Pm}\right]^{\frac{-1}{(\rho+1)}}$$

Executing the multiplications on the RHS above, leads to:

$$\varepsilon_{\frac{Qm^*}{Qd^*},\frac{Pd}{Pm}} = \frac{1}{(\rho+1)} \left[\frac{\delta}{(1-\delta)}\right]^{\frac{1-1}{(\rho+1)}} \left[\frac{Pd}{Pm}\right]^{\frac{1-\rho-1+\rho+1}{(\rho+1)}} \Rightarrow$$

$$\varepsilon_{\frac{Qm^*}{Qd^*},\frac{Pd}{Pm}} = \frac{1}{(\rho+1)} \qquad (\rho+1) \neq 0 \Rightarrow \rho \neq -1$$

A positive elasticity of substitution ensures that the share of imported goods in the mix of the composite commodity increases if the price of the domestic good increases relative with respect to the price of the imported good, and vice-versa. This implies:

$$\varepsilon_{\frac{Qm^*}{Qd^*},\frac{Pd}{Pm}} > 0 \Rightarrow \frac{1}{(\rho+1)} > 0 \Rightarrow \rho > -1$$

However, note that in the CES function ρ appears at the denominator of the exponent. This implies that:

$$\rho \neq 0 \Rightarrow \frac{1}{(\rho+1)} \neq 1 \Rightarrow \varepsilon_{\frac{Qm^*}{Qd^*},\frac{Pd}{Pm}} \neq 1$$

i.e. the elasticity of substitution, when using a CES, cannot take the value 1, as in the case of the Cobb Douglass. It can approximate to 1 for $\rho \to 0$.

On the other hand, the elasticity of substitution cannot take the value 0 for any value of ρ. It can only approximate to 0 for $\rho \to \infty$. To summarize, when using the CES function, the links between the value of ρ and the elasticity of substitution are as follows:

$$-1<\rho<0 \Rightarrow 1<\varepsilon_{\frac{Qm^*}{Qd^*},\frac{Pd}{Pm}}<\infty$$

$$\rho>0 \Rightarrow 0<\varepsilon_{\frac{Qm^*}{Qd^*},\frac{Pd}{Pm}}<1$$

$$\rho<-1 \Rightarrow \varepsilon_{\frac{Qm^*}{Qd^*},\frac{Pd}{Pm}}<0$$

$$\rho \neq 0, \rho \neq -1$$

Calibration of the Armington functions in the model

In the model, the rho (exponent) for each commodity, which is both imported and produced domestically, is worked out from the elasticity of substitution SIGMAQ, provided in the database of specific country data:

$$\varepsilon_{\frac{Qm^*}{Qd^*},\frac{Pd}{Pm}}=\frac{1}{(\rho+1)} \Rightarrow \rho=\frac{1-\varepsilon}{\varepsilon}$$

The delta (share parameter) is worked out from the tangency condition with prices and quantities at the benchmark: $\frac{Qm_0^*}{Qd_0^*}=\left[\frac{\delta}{(1-\delta)}\frac{Pd_0}{Pm_0}\right]^{\frac{1}{(\rho+1)}}$

After some algebraic calculations, this leads to[229]:

$$\delta=\frac{\frac{Pm_0}{Pd_0}\left[\frac{Qm_0}{Qd_0}\right]^{(\rho+1)}}{1+\frac{Pm_0}{Pd_0}\left[\frac{Qm_0}{Qd_0}\right]^{(\rho+1)}}$$

Once delta is worked out, it is replaced in the Armington production function in order to work out alpha (scale parameter).

$$Qq=\alpha\left[\delta Qm^{-\rho_c}+(1-\delta)Qd^{-\rho_c}\right]^{-\frac{1}{\rho_c}} \Rightarrow$$

$$\alpha=Qq\left[\delta Qm^{-\rho_c}+(1-\delta)Qd^{-\rho_c}\right]^{\frac{1}{\rho_c}}$$

[229] Note that in the model the numerator is called; PREDELTA. Therefore:

$$PREDELTA=\frac{Pm_0}{Pd_0}\left[\frac{Qm_0}{Qd_0}\right]^{(\rho+1)} \text{ therefore: } \delta=\frac{PREDELTA}{1+PREDELTA}$$

12.3. CET functions for Export versus Domestic Supply.

The problem of trading-off the output to be sold on the domestic market QD versus the output to be exported QE is addressed by the producer by trying to maximise his/her aggregated sales revenue on domestic and export markets. The producer faces a technical constraint expressed by means of a Constant Elasticity of Transformation (CET) function, where QD can be transformed into QE and vice-versa but QD is not a perfect transformation of QE, in a one-to-one way. This means that a reduction of one unit of QD allows one to obtain less than or more than one unit of QE according to the relative quantity QE/QD. Broadly speaking, if QE/QD is relatively high, a reduction of a unit of QD will allow only small increases of QE. Vice-versa, if QE/QD is small, a reduction in QD will allow large increases of QE.

The maximisation problem can be set as follows:

$$\underset{Qe,Qd}{Max}\, PX\overline{QX} = PeQe + PdQd$$

$$\text{s.t. } QX = \alpha\left[\delta Qe^{-\rho} + (1-\delta)Qd^{-\rho}\right]^{\frac{1}{-\rho}}$$

Using the method of Lagrange multipliers, the maximisation problem amounts to:

$$\underset{Qe,Qd,\lambda}{Max}\, L = PeQe + PdQd - \lambda\left\{\alpha\left[\delta Qe^{-\rho} + (1-\delta)Qd^{-\rho}\right]^{\frac{1}{\rho}} - QX\right\}$$

The revenue maximisation problem, which can be solved in a similar way as the Armington cost minimisation problem described in the section above, gives rise to two supply functions, one for Qe and one for Qd which are direct functions of own-prices (Pe and Pd respectively) and inverse functions of the cross-prices (Pd and Pe respectively). In an alternative, the quantity ratio[230] can be derived from the ratio of the two first-order conditions:

$$\frac{Qe^*}{Qd^*} = \left[\frac{\delta}{(1-\delta)}\frac{Pd^*}{Pe^*}\right]^{\frac{1}{(\rho+1)}}$$

The elasticity of transformation can be worked out, as above as[231]:

---

[230] This ratio enters in the set of equations of the model. In this model however, the CET is written with the positive power ρ, which implies that the quantity ratio is reported with the exponent $(-\rho+1)$ or analogously, with exponent $(\rho-1)$ but the inversed basis, as follows: $\frac{Qe^*}{Qd^*} = \left[\frac{(1-\delta)}{\delta}\frac{Pe}{Pd}\right]^{\frac{1}{(\rho-1)}}$

[231] From now on we drop the star signalling optimality, for simplicity of notation.

$$\varepsilon_{\frac{Qe}{Qd},\frac{Pd}{Pe}} = \frac{\partial \frac{Qe}{Qd}}{\partial \frac{Pd}{Pe}} \frac{\frac{Pd}{Pe}}{\frac{Qe}{Qd}} = \frac{1}{(\rho+1)} \left[\frac{\delta}{(1-\delta)}\right]^{\frac{1}{(\rho+1)}} \left[\frac{Pd}{Pe}\right]^{\frac{1}{(\rho+1)}-1} \frac{Pd}{Pe} \left[\frac{\delta}{(1-\delta)}\right]^{\frac{-1}{(\rho+1)}} \left[\frac{Pd}{Pe}\right]^{\frac{-1}{(\rho+1)}}$$

After some manipulations we get:

$$\varepsilon_{\frac{Qe}{Qd},\frac{Pd}{Pe}} = \frac{1}{(\rho+1)} \left[\frac{\delta}{(1-\delta)}\right]^{\frac{1-1}{(\rho+1)}} \left[\frac{Pd}{Pe}\right]^{\frac{1-\rho-1+\rho+1}{(\rho+1)}} \Rightarrow$$

$$\varepsilon_{\frac{Qe}{Qd},\frac{Pd}{Pe}} = \frac{1}{(\rho+1)}$$

Note that the denominator has to be different from zero, therefore:

$$(\rho+1) \neq 0 \Rightarrow \rho \neq -1$$

We assume the elasticity of transformation to be negative[232]:

$$\varepsilon_{\frac{Qe}{Qd},\frac{Pd}{Pe}} < 0 \Rightarrow \frac{1}{(\rho+1)} < 0 \Rightarrow \rho < -1$$

Note also that ρ can also be expressed as function of the elasticity of transformation:

$\varepsilon_{\frac{Qe}{Qd},\frac{Pd}{Pe}} = \frac{1}{(\rho+1)} \Rightarrow (\rho+1) = \frac{1}{\varepsilon_{\frac{Qe}{Qd},\frac{Pd}{Pe}}}$, so that[233]:

$$\rho = \frac{1}{\varepsilon_{\frac{Qe}{Qd},\frac{Pd}{Pe}}} - 1 \ .$$

This implies that, when using a CET, the elasticity of substitution cannot be zero:

$$\varepsilon_{\frac{Qe}{Qd},\frac{Pd}{Pe}} \neq 0$$

Calibration of the CET parameters ρ, δ and α

The calibration of the CET parameters is analogous to the calibration of the CES. ρ is calculated from the elasticity parameter as above.

---

[232] Note that in the model, given the change in the sign of ρ in the CET, the elasticity results:

$\varepsilon_{\frac{Qe}{Qd},\frac{Pd}{Pe}} = \frac{1}{(1-\rho)}$. Therefore: $\varepsilon_{\frac{Qe}{Qd},\frac{Pd}{Pe}} < 0 \Rightarrow \frac{1}{(1-\rho)} < 0 \Rightarrow \rho > 1$.

[233] Note that, for some reasons, in the model, the elasticity value (parameter *SIGMAT*) is inserted in the country database as a positive value. Therefore, ρ has to be calculated as: $\rho = \frac{1}{SIGMAT} + 1$. This ensures a positive ρ (and always greater than 1) and, given the positive sign of the exponent ρ in the CET, leads to a negative elasticity of transformation, as desired.

δ is worked out starting from the quantity ratio, where prices and quantities are set at the benchmark level:

$$\delta = \frac{\frac{Pe_0}{Pd_0}\left[\frac{Qe_0}{Qd_0}\right]^{(\rho+1)}}{1+\frac{Pe_0}{Pd_0}\left[\frac{Qe_0}{Qd_0}\right]^{(\rho+1)}}$$ or, analogously, after some manipulations:

$$\delta = \frac{1}{1+\frac{Pd_0}{Pe_0}\left[\frac{Qd_0}{Qe_0}\right]^{(\rho+1)}}$$

Note that $0 < \delta < 1$ as the denominator is always greater than 1 because it is 1 plus a positive quantity. Indeed, the price ratio is positive, the quantity ratio is positive as well and it keeps the positive sign even if powered with whatever exponent (for whatever value of rho).

Note also that the restriction of the elasticity of transformation to be negative implies that $\rho < -1$, thus $(\rho+1) < 0$. This leads, other things equal, to $\delta \to 0$ if $\frac{Qd}{Qe} \to 0$, as this implies that $\left[\frac{Qd}{Qe}\right]^{(\rho+1)} \to \infty$ as well as all the denominator. On the other hand $\delta \to 1$ if $\frac{Qd}{Qe} \to \infty$. In other words, a large share of exports implies a small delta, vice-versa, a small share of exports implies a large delta.

Closure of the "Rest of the World" account.

So far, in discussing the different macro-closures, we made reference to a "closed economy" simplified CGE.
The exchange rate (varable *EXR*) in the CGE model adopted plays the role of converting prices on internationally traded commodities, as well as incoming and outgoing flows of transfers (e.g. remittances for factor services) expressed in foreign currency, into domestic currency.

The variable *EXR* is a "real exchange rate", as the numerarire of the model is the domestic price level (consumer price index- variables *CPI* – or producer price index), so that EXR, i.e the "price" of the foreign currency is expressed relative to the domestic price level.

In general terms, the "real exchange rate" for period (or scenario) 1, RER_1 is the quantity of domestic currency expressed in real terms, i.e. at constant prices (net of

the domestic price changes) required for buying one unit of foreign currency at constant (expressed in real terms as well).[234]

$RER_1 = \frac{DC_1 / PD_{1,0}}{FC_1 / PF_{1,0}}$, where: DC_1 is the quantity of domestic currency required in period (scenario) 1 to buy one unit of foreign currency (FC_1) in period (scenario) 1, $PD_{1,0}$ and $PF_{1,0}$ are respectively the domestic and foreign price indexes for period (scenario) m1 with respect to period (scenario) 0.

EXR plays the role of equilibrating the current external account (equation *CURACCBAL* in the model), if the deficit in foreign currency (variable FSAV) is exogenously fixed.

In its simplest version (assuming one import commodity and one export commodity and no transfers), the model for the current external balance is as follows:

$$QM \cdot PWM - QE \cdot PWE = FSAV \quad (1)$$

$$QM = f\left(\frac{PM}{PD}\right) \quad (2)$$

$$PM = PWM \cdot EXR \quad (3)$$

$$QE = g\left(\frac{PE}{PD}\right) \quad (4)$$

$$PE = PWE \cdot EXR \quad (5)$$

where:

$QM \cdot$ and QE are respectively the quantity of imports and exports, PWM and PWE are respectively the international price of imports, PM and PE are respectively the prices of imports and exports in domestic currency, *PD* is the domestic price level, *FSAV* and *EXR* are defined as above, *f* and *g* are functional forms for the demand of imports (2) and the supply of exports (4) respectively, (1) is the current account balance.

Assuming that the domestic price level is given (determined in other parts of the model), the international prices are exogenous and the deficit of the current account FSAV is exogenously fixed as well, the model becomes:

[234] Note that to calculate "real" exchange rates, a "benchmark" (period or scenario) is needed, which allows to express the two currencies in terms of their constant purchasing power within their respective domestic economic systems.

$$QM \cdot \overline{PWM} - QE \cdot \overline{PWE} = \overline{FSAV} \quad (1a)$$

$$QM = f\left(\frac{PM}{\overline{PD}}\right) \quad (2a)$$

$$PM = \overline{PWM} \cdot EXR \quad (3a)$$

$$QE = g\left(\frac{PE}{\overline{PD}}\right) \quad (4a)$$

$$PE = \overline{PWE} \cdot EXR \quad (5a)$$

i.e. a model of five equations with five variables: QM , QE PM , PE and EXR .

Any shift in the international prices of imports and/or exports has to be adjusted, in order to satisfy the (1a), by changes of *QM* and *QE*. These physical quantities are functions of PM and PE respectively, which in turn are functions of the exchange rate EXR and of PWM and PWE respectively. The exchange rate therefore has to adjust in order to alter the prices of imports and exports with respect to the domestic prices, in such a way that *QM* and *QE* vary up to a point where the (1a) is satisfied.

The (1a) can be interpreted also as the equilibrium condition of the Foreign Currency (FC) market, for any given level of the exchange rate EXR , where:

$$FC_d = QM \cdot \overline{PWM} \quad (6)$$

$$FC_s = QE \cdot \overline{PWE} + \overline{FSAV} \quad (7)$$

represent respectively the quantity of FC demanded for importing goods and the quantity of FC supplied by exporting goods plus the currency made available by the foreign investors.

Substituting (2a) in (6) and (4a) in (7) yields:

$$FC_d = f\left(\frac{PM}{\overline{PD}}\right) \cdot \overline{PWM} \quad (6a)$$

$$FC_s = g\left(\frac{PE}{\overline{PD}}\right) \cdot \overline{PWE} + \overline{FSAV} \quad (7a)$$

Furthermore, substituting (3a) and (5a) in (6a) and (7a) respectively, yields:

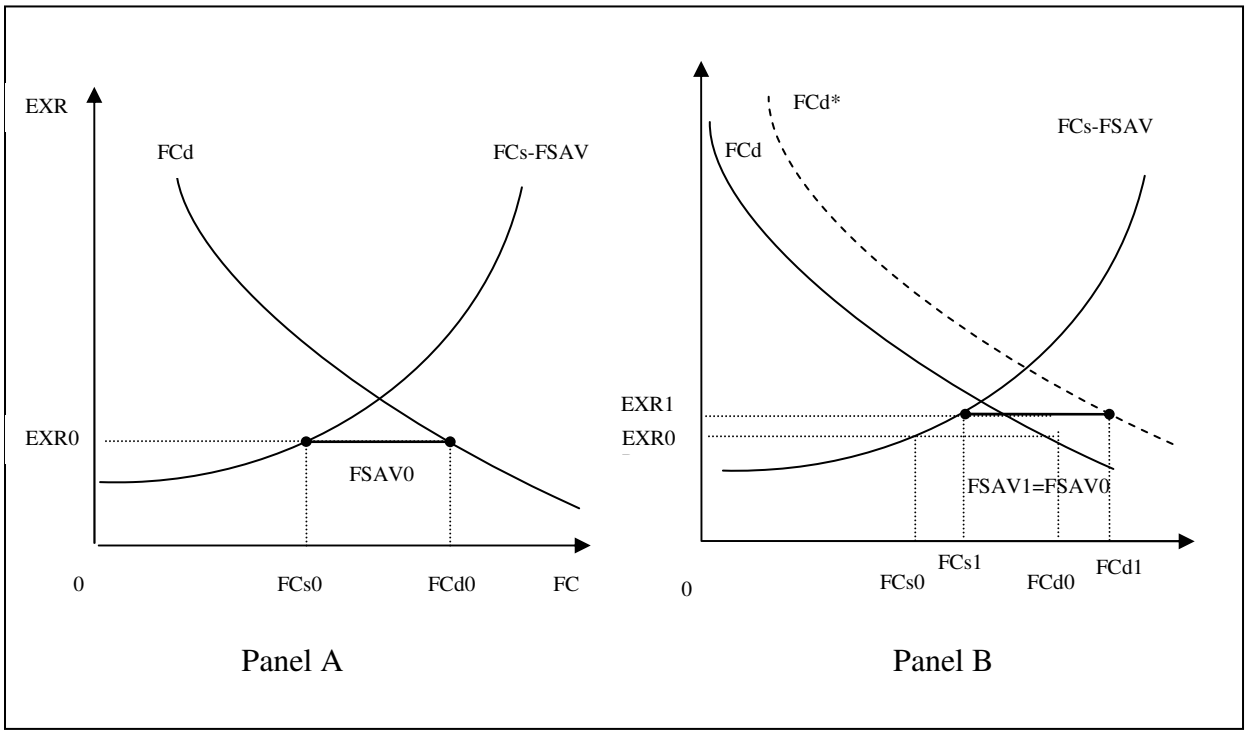
$$FC_d = f\left(\frac{\overline{PWM} \cdot EXR}{\overline{PD}}\right) \cdot \overline{PWM} \quad (6b)$$

$$FC_s = g\left(\frac{\overline{PWE} \cdot EXR}{\overline{PD}}\right) \cdot \overline{PWE} + \overline{FSAV} \quad (7b)$$

To ensure the convergence of the foreign currency market, the first derivatives of the FC demand and supply should have opposite signs. It is expected that, when EXR increases, other things equal, imports decrease and exports increase, i.e. that FC_d and FC_s be downward and upward sloping functions w.r.t. EXR, respectively.

The foreign currency market can therefore be represented as in figure A1, panel A. At $EXR = EXR0$ the excess demand of foreign currency is compensated by the level of $FSAV = FSAV0$.

Figure A1 The Foreign currency market: adjustment of the EXR

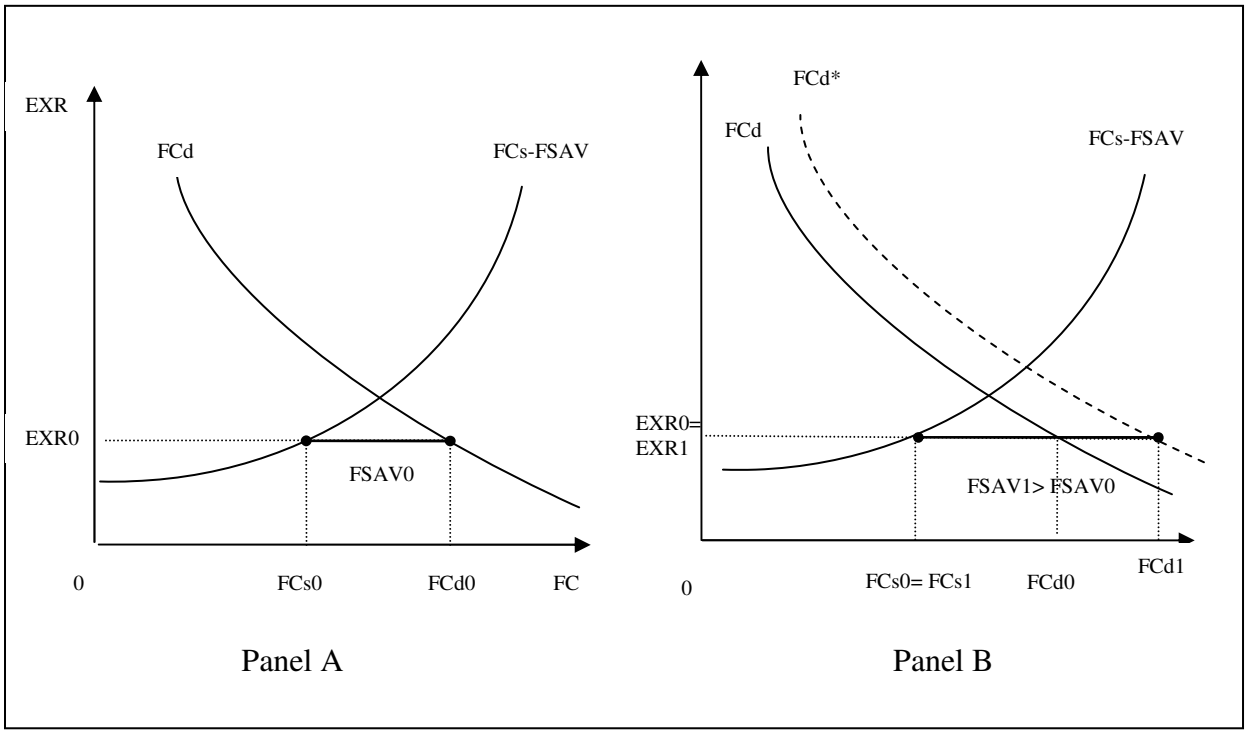


A shift in an international price, say of imports, other things equal will shift the FC demand curve upward (see panel B of figure A1). If the deficit of the balance of trade has to be kept at the level $FSAV = FSAV0$, the exchange rate has to increase up to the level $EXR1$.

If, in alternative the RER is fixed, on the foreign currency market shifts in the deficit/surplus are generated. If, e.g.

Figure A2 Foreign currency market: adjustment of the deficit/surplus

m



Adjustments of the real exchange rate under fixed nominal exchange rate

In a concrete situation where the nominal exchange rate is fixed, as in the case of the Franc CFA with respect to the Euro, the real exchange rate has to adjust via adjustments in the ratios of price changes. This is apparent if the real exchange rate formula is rewritten as:

$$RER_1 = \frac{DC_1}{FC_1}\frac{PF_{1,0}}{PD_{1,0}} \qquad (8)$$

The same formula can be written for period (scenario) 0:

$$RER_0 = \frac{DC_0}{FC_0}\frac{PF_{0,-1}}{PD_{0,-1}} \qquad (9)$$

The first factor in the right hand side of the (8), $\frac{DC_1}{FC_1}$, is the nominal exchange rate in period (scenario) 1. As this is by definition equal to that of period (scenario) 0, i.e.

$$\frac{DC_1}{FC_1} = \frac{DC_0}{FC_0} \qquad (10)$$

In the case of an upward shift of the demand of foreign currency due to e.g. a rise in the international price of imports, the RER has to increase by means of an upward shift of the second factor, i.e. it has to be:

$$\frac{PF_{1,0}}{PD_{1,0}} > \frac{PF_{0,-1}}{PD_{0,-1}} \qquad (11)$$

Assuming that the change of foreign prices (i.e. the foreign inflation) $PF_{1,0}$ is exogenous (as it is in almost all practical situations) and fixed, the increase in the RER occurs by means of a decrease of the domestic inflation, i.e. it has to be : $PD_{1,0} < PD_{0,-1}$. In summary, to keep the domestic currency pegged to the foreign currency, yet obtaining an increase of the RER, the domestic inflation has to decrease. Following Sadoulet &De Janvry 1995[235], this may happen because an increased demand of foreign currency generates an increased deficit in the current account balance. The central bank, to maintain the nominal exchange rate, has to sell foreign against domestic currency, thus absorbing liquidity in the system. This reduced money supply entails a reduction of the general level of domestic prices, thus reducing $PD_{1,0}$ with respect to $PD_{0,-1}$.

Slope of the demand and supply of the foreign currency

Note that *QM* and *QE* are respectively functions of $\frac{PM}{\overline{\overline{PD}}}$ and $\frac{PE}{\overline{\overline{PD}}}$ (equations 2a and 4a), and $\frac{PM}{\overline{\overline{PD}}}$ and $\frac{PE}{\overline{\overline{PD}}}$ are both functions of EXR: (equations 3a and 5a, respectively).

Therefore, the first derivative of FC_d and FC_s with respect to EXR can be expressed, by means of the chain rule for the derivatives of functions of functions, as:

$$\frac{\partial FC_d}{\partial EXR} = \frac{\partial QM}{\partial\left(\frac{PM}{\overline{\overline{PD}}}\right)} \cdot \frac{\partial PM}{\partial EXR} \cdot \overline{PWM} \qquad (12)$$

$$\frac{\partial FC_s}{\partial EXR} = \frac{\partial QE}{\partial\left(\frac{PE}{\overline{\overline{PD}}}\right)} \cdot \frac{\partial PE}{\partial EXR} \cdot \overline{PWE} \qquad (13)$$

As $\frac{\partial PM}{\partial EXR}$ and $\frac{\partial PE}{\partial EXR}$ on the basis of (3a) and (5a) are $\overline{PWM}$ and $\overline{PWE}$ respectively, (12) and (13) can be written as:

$$\frac{\partial FC_d}{\partial EXR} = \frac{\partial QM}{\partial\left(\frac{PM}{\overline{\overline{PD}}}\right)} \cdot \overline{PWM}^2 \qquad (12a)$$

$$\frac{\partial FC_s}{\partial EXR} = \frac{\partial QE}{\partial\left(\frac{PE}{\overline{\overline{PD}}}\right)} \cdot \overline{PWE}^2 \qquad (13a)$$

This implies that:

[235] Sadoulet E, De Janvry A. 1995: Quantitative development policy analysis Johns Hopkins Ed. p.215.

$$\frac{\partial FC_d}{\partial EXR} < 0 \qquad (14)$$

$$\frac{\partial FC_s}{\partial EXR} > 0 \qquad (15)$$

On the basis of (12a) and (13a), therefore, it has to be that:

$$\frac{\partial QM}{\partial\left(\frac{PM}{PD}\right)} < 0 \qquad (16)$$

$$\frac{\partial QE}{\partial\left(\frac{PE}{PD}\right)} > 0 \qquad (17)$$

i.e. that the imports decrease as the relative price of imports with respect to the domestic price level increase and that exports increase as the relative price of exports with respect to the domestic price level increase.

In the CGE model The (16) and (17) are assured by the proper signs of the elasticities of substitution between imports and domestic commodities in the CES functions and of the elasticities of transformation of exports into domestic commodities in the CET functions.